AVIATION

The Oldest American Aeronautical Magazine

OCTOBER, 1930

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A McGraw-Hill Publication

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The Oldest American Aeronautical Magazine

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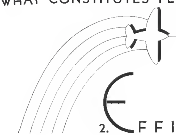

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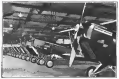

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The Oldest American Aeronautical Magazine

EDWARD P WARNER, *Editor*

Volume 29 . . . ***October, 1930*** . . . Number 4

WHAT NEXT IN AIR TRANSPORT?

REGULAR and long-continued passenger transportation by air in the United States is nearing its third anniversary. Taken with a dozen years of air mail operations, it has provided enough background to make some reasonable estimate of the future. It is no secret from anyone who follows American aeronautics that passenger carrying has so far proved to be something less than an El Dorado European countries can tell the same story It is, in fact, a general rule that a line running for a long period over a thickly settled region with well developed surface transport facilities runs at a loss unless there is some sort of direct government support

The discouraging factor in air transportation has been the balance sheet The factor of encouragement has been the popular response After a year of uncertain and varying public interest, the lines got their grip with the beginning of the rate-cutting era ten months ago Since that time there has been no recession Traffic has steadily increased It has not increased far enough, or fast enough There is room not only for a continuance of the past growth, but for a more rapid acceleration Nevertheless we have been moving in the right direction

The problems of air transport are only secondarily technical In the first instance they are economic and psychological How can we persuade a greatly increased number of travelers that they ought to patronize the air lines at the rates that it is necessary for the companies to charge in order to make a profit? How can we lower the level of those rates?

At the present time the economics of the subject are lost in a maze of uncertainty The purported costs of operating three-engined transports carrying from ten to fourteen passengers fluctuate like the thermometer. Within the past month we have received reports of records, for lines operating within the United States, ranging all the way from thirty cents to \$1 75 a mile. The one thing that is clear is that in practically all cases either an increase in rates or an increase in inherent operating efficiency of the equipment used is going to be required in order to wipe the red ink off the ledger

The air transport operators are, or should be, fortunate in that as a general rule they are not competing with each other In a few cases, of courses, there are two or more parallel lines working for the same business but in a majority of instances the companies feed traffic to each other, and they are doing themselves a very poor service when they conceal data from each other The attempt to build up nation-wide systems through holding companies and to round out the map of lines under a common ownership by absorbing independents has put three or four leading groups in very conscious rivalry with each other It has perhaps been responsible for the secrecy that has often prevailed The time has come to break away from it in the common interest There ought to be a free and full exchange, not only of traffic statistics but of accounting data In particular, something like a common accounting system should be agreed upon and adopted Railroads have long been constrained by the Interstate Commerce Commission to practice bookkeeping uniformity The motor truck and motor coach operators are now diligently engaged in seeking means of providing it for themselves

The air lines should be doing the same. At the present time it is quite impossible to interpret alleged operating costs per mile without making a long series of inquiries into the assumptions upon which they have been based.

Once we know what costs really are, or may reasonably be expected to become with equipment actually within reach, we shall know how much rates have to be elevated. Plans can be made accordingly. There is no doubt that the traveling public will have to pay an extra fee for the speed and convenience of air transport. They will have to pay enough extra to make it profitable. Rates may ultimately settle down at six cents a mile average, or at ten, or at some other figure. Our own guess for three years hence is half-way between those two levels. However that may be, the service must thereafter be made and kept attractive enough so that the increased charges will not destroy the traffic.

In seeking to increase the value of air service there has been too much talk of speed. Passengers who will not pay a small excess over the railroad fare for planes cruising at 110 miles an hour will not be willing to pay a larger excess for any higher figure within the realm of reasonable probability. The fluctuations of speed are now a minor factor in determining the traffic of any individual line. They are far less important than variations of rate, of supposed safety, and of anticipated regularity of service.

Increased safety is as important as increased economy. The present record is by no means good enough to permit of abandoning efforts for further improvement. Nevertheless, American air transport operators can flatter themselves that never at any time, anywhere else in the world, has there been so good a safety record on anything like the same amount of passenger traffic as has been made in the United States during the last twenty months.

Reliability is equally significant. We in the industry are used to occasional cessations of service due to fog and make allowances for them. The non-aeronautical traveler finds a cancelled trip a very discouraging experience, and next time he is likely to plan to go by rail in the first place. Totally blind commercial flying is a thing of the remote future, but a really aggressive use of existing instruments and of existing knowledge of radio navigation should make it possible to fly with visibility far worse than is now considered permissible. Year-round regularity records must be raised to 98 per cent or better, not only in Southern California and Arizona but throughout the land. Just as surely as safety has been increased in the last eight years, reliability of operation can be increased in the next five.

We have occasionally been rebuked in the past for cynicism or pessimism or lack of "constructiveness" because these pages have been built upon realism, not upon rainbows. But we have now a prophecy to which not even the most generous optimist should take exception. We believe that if the air transport industry takes advantage of its opportunities, and is properly cooperative within its own parts, the carrying of passengers by air will be upon a self-supporting and profitable basis, without one penny of direct support from the government, within three years from today.

THE POST OFFICE AND AIR TRANSPORT

WHEN the Watres Bill was under debate in Congress we found ourselves almost alone in sounding a very conservative note of very limited approval. While the measure was being widely acclaimed as the assured salvation of air transportation in the United States, we were unable to discover that it possessed any unique virtue. It had, as introduced and as it finally passed, some excellent provisions, but the ends for which they provided could have been accomplished in large part under existing legislation. Taken as a whole it apparently expressed the personal feelings of Postmaster-General Brown, who had criticized the air mail situation then existing with a sweeping severity for which we have never discovered the justification.

Since the passage of the Watres Act, as before, the development of transportation by air in the United States will be determined largely by the gross amount of government support provided. A million dollars, or any other sum, devoted to mail contracts will go just so far. It cannot be magically extended by writing a new set of contracts using a lot of new language. The Watres Act did not guarantee any increase in the aggregate sum available. It permitted a redistribution among the recipients of the contracts, but that could have been accomplished without any fundamental change in the basis of contracting under the law that already provided for superseding contracts by negotiated route certificates. The appropriations to be made for 1932 and succeeding years are the really critical factor for the air transport industry. Through 1932 and 1933 Congress should be very liberal. By the end of that period we believe that the transport lines will be on the high road to self-support and that government assistance can be rapidly scaled down.

Everything depends on money,—and on intelligent administration. All sorts of legal frameworks could be made to work satisfactorily, with wise guidance and sympathetic cooperation with the industry in Washington. How has administration so far proceeded?

First, there was issued a schedule of rates of compensation that not only took into account the inherent difficulties of the route that had to be flown but also went on to promote the use of certain definite types of equipment and to offer incentives for the operators to adopt certain methods. Bonus payments for the installation of radio are perhaps acceptable, since radio contributes to reliability, and there was no definite provision for award-

ing regularity of service otherwise. Bonuses for carrying passengers in the same planes with the mail were at least very questionable, and were tolerable only because they were so small that they probably would not have much influence on regular mail contractors. The bonus allowed for the use of multi-motored equipment was definitely undesirable, as hindering free experiment and free choice of that type of airplane which the operators might find most economical and most efficient. As a matter of fact the Post Office Department issued this striking endorsement of the multi-engined design just at the time when a marked revival of interest in large single-engined transport planes was becoming apparent.

Second, the Department issued an order that all air mail lines operating by day must use planes capable of carrying passengers as well as mail. Not content with offering additional payment for a composite type, the Postmaster General definitely insisted on their introduction on all daylight runs.

It was felt by many air mail contractors three years ago that the handling of mixed passenger and mail loads over mountainous country and through bad weather conditions was often undesirable. We agreed with them then, and we still agree. The mail can go through at times with the pilot sitting on his parachute under conditions such that the acceptance of passengers would be indefensible. Carrying passengers, the pilot cannot have a parachute for his own protection. If bad weather is encountered on route with a mixed load, is he to turn back with his passengers to a good field, to try and push through regardless, or to land them at an intermediate field far from the nearest means of surface transportation and abandon them there while he puts on a parachute and goes up above the clouds by himself? This is not a hypothetical dilemma. It actually arises. The operator who wants to carry both mail and passenger on separate services, giving special treatment to each, should have the privilege of doing so. The Post Office Department order took his discretion away from him.

At this point we interpolate a defense of the Department against charges of procrastination and obstructiveness that have been freely made. It is over four months since the Watres Act was signed, and little has yet been done to apply it,—but it is a colossal task to re-draw the air route map of the country and evolve a scheme of compensation. The Controller-General's decision on "extensions" has upset many plans tentatively made. The delay has been bitterly hard on the operators, but they would have suffered even more in the long run from undue precipitancy in arranging the general revision that had been decided upon.

Third came the invitations to bid on the two new transcontinental routes, and the stipulation that every bidder must have had protracted experience in regular night operation. The Watres Bill was carefully phrased to provide protection for the interests of pioneer operators in air transport. With the invitation for the transcontinental bid, it became evident that the Post Office Department has a special definition of pioneer, to include only those operators who have already received air mail contracts. Companies that had opened passenger lines at their own expense, with no government assistance of any kind, were to be eliminated from consideration, for their passenger flying has of course all been done by day. In practice they have not been entirely debarred. The principal effect of the rulings has been to encourage the making of arbitrary combinations of companies to include at least one night mail operator, spreading its beneficent influence over all its associates and making their combined bid legal.

If the Watres Act were purely a postal measure, there would be no possible objection to this, and the Post Office Department would be fully justified in giving preference to the companies with which it is accustomed to dealing and which have already had experience in handling mail. But the Watres Act was not simply a postal measure. It was intended to encourage American air transport in every sphere. It is with the greatest regret that we see it used to take out of an operator's hands the making of important decisions about the organization of his own business, or to deny any established and experienced company the opportunity of submitting an individual bid.

LIGHT PLANE TOURS AND THE PRIVATE FLYER

THE National Air Tour has again gone its way. As usual, the entry list contained a mixture of almost every known type of airplane. Including the accompanying machines, they ranged in horsepower from thirty to twelve hundred, in capacity from one man and one suitcase to a dozen occupants and great loads of baggage. It was more than ever apparent this year, thanks largely to the sudden growth of interest in very light airplanes, that no single set of rules and no single formula can meet so wide a range of conditions. The tour is run at present primarily in the interest of transport aviation, which is quite as it should be. The plane for the private pilot comes in as an afterthought, and accommodates itself to the transport plane as best it can. The need for an entirely separate event, open only to machines of private-ownership type and with every effort made to persuade private owner-pilots to enter on their own account, is glaringly obvious.

There is run each year in Europe the International Challenge of "Tourism," with planes from half a dozen countries participating, and with the scoring system adapted purely to the private owner's problem. In the 1930 edition of that tour, just completed, 60 machines started and 33 finished successfully. Most of them, to be sure, were entered by manufacturers, but a good proportion of private individuals went in on their own

account in their own planes, and we have to thank a British sportsman for the only display that was made of an American product,—which put up a most creditable performance

Italy, disgruntled over the administration of the 1929 Survey, has organized a rival event of its own, and that, too, appears to be attaining full success Only in the United States is there no opportunity to put the small and low-priced plane into a touring competition expressly designed to meet its conditions

Such a tour should be planned It should be a joint undertaking of the American and Canadian industries It need not extend over more than ten days, and it need not be elaborately or expensively organized For a group of stock planes, of types selling at $5,000 or less, with private owners at the controls of a good proportion of the total number of entries, to go on a three-thousand mile journey around a selected part of the country would furnish ideal publicity for private flying Whether or not such an event could be made worth while would depend only upon the manufacturers of the light planes and upon the present-day sportsmen pilots Given the interest on their part which ought reasonably to be expected, success would be almost assured

THE R-100 GOES CALLING

SINCE we last published the box score a year ago, the record of the rigid airship has continued to improve. It is still true that there have been no disasters to ships of that type on the North Atlantic route. Eleven wholly successful crossings have been made The flight on which the Graf Zeppelin had to turn back still constitutes the only departure from a perfect record

Last month's flight from England to Canada and return is especially significant The R 100 becomes the fourth airship to establish itself on a route on which more than half the crossings stand to the credit of a single vessel Its trip lends a new significance to the slogan of "Imperial Air Routes," which has been chanted so persistently in Great Britain and the Dominions for several years past Most interesting of all from the technical point of view, this is the first airship showing pronounced departures from the Zeppelin type of construction to negotiate the Atlantic. Upon its brilliant demonstration we congratulate all supporters of the airship everywhere, especially our British friends, and most especially Commander Burney and Mr Wallace and other members of his engineering staff

Out of the flight there loom but two disturbing episodes We do not count the damaged fabric on a stabilizer as one of them, for that comes under the head of a minor mishap, easily to be avoided in the future

Much more disquieting are the apparent unconcern of the British public, on the one hand, and the rumors that the ship is to be increased in volume on the other

Despite the most heroic efforts by the present Air Minister and his predecessor, Great Britain is still definitely dubious of the airship. Despite the flight of the R-100 a flood of letters to the *London Times* belittling the airship program sound the keynote We believe that they are too conservative, that they are overlooking a bright prospect at their very doors, and while that might appear to redound to the benefit of an American industry with which the British one is to be competitive, we none the less deeply regret it, for airship development is an international undertaking, and in order that airships may be fully successful anywhere they need the sympathy and support of many countries.

Second in order comes the story of the intended lengthening of the ship, and here, if the report be valid, it is the over-enthusiasm of airship designers and would-be operators that is at fault Holding always in view an ideal far beyond anything yet obtained, they are so impatient with the present craft that they do not always even allow the first trial flight to be completed before issuing a pronunciamento for bigger and better ships. We have seen it in the United States The British are seeing it now It has even been seen in Germany, where Dr Eckener spoke almost scornfully of the capacities of the Graf Zeppelin, and dwelt eagerly upon the need of greatly increased size and speed, on returning from one of his voyages to America

The urge for technical improvement is indispensable, but the taxpayer and his government cannot be expected to go on supporting it indefinitely without having some material results to show The Graf has done a great service to the airship cause in the last two years by carrying at least a little paying cargo on her trips and by giving them the appearance of genuine commercial ventures. It may be that the British have now discovered that the R-100 and R 101 would be more serviceable on long routes if they were larger. It may be that some recession from the original operating plans will be required It may be that when the two ships now under construction at Akron are completed it will be found that they too, great though their dimensions are, could be improved by increase in volume.

But in the meantime, definite commercial employment should be found for the ships as they exist The general public are not going to be willing to approve continued expenditures for the support of airship experiments unless they can see some material return on each contribution already made They are not going to be content with the assurance that all that is needed was a little more size and that next time it will be all right,—nor need they get along on that barren nourishment There is plenty that can be done with airships of today. Some of it should be undertaken Existing craft should be kept steadily at some useful work This is a word of warning that may be applied in Cardington, Friedrichshafen, Washington, or wherever it may fit.

The Trend of Activities

BY R SIDNEY BOWEN, JR.

INDUSTRY activity during the last few weeks seems to have been more prominent in the air than on the ground There were, however a few ground developments of interest and importance Therefore in the same manner that the airplane goes over the ground and then into the air we shall deal with ground activities before going up for altitude accomplishments

Bigger and better sales being the slogan of every member of the industry, it seems altogether fitting to investigate that item first

PRODUCTION AND SALES

ACCORDING to a report recently issued by the Aeronautical Chamber of Commerce there were 39 less air planes sold during the month of July than in June The exact figures are: 321 planes sold in June, and 282 planes sold in July Those figures, of course, include military ships Commercially speaking there were 227 planes sold in June and 218 in July By comparing those figures with the actual commercial production figures (178 for June and 181 for July) we note that although July saw a production increase of 3 planes, it also saw a sales decrease of 9 planes

The engine production and sales figures for the two months are even more disheartening Total engines produced in June numbered 391 in July they totaled 334, a decrease of 57 engines For June commercial engines totaled 239, and for July it was 166, a decrease of 73 engines Commercial engines sold in June totaled 258, for July they totaled 152, a decrease of 106 engines

All of which indicates very clearly that beginning with the first of July the task of moving last year's production off the shelf became more difficult and less successful There are those who might refer to the decline as being a seasonal matter That, however, is hardly possible as it is quite obvious to all that July is one of the nation wide perfect months for flying A decrease during the next month, or this month for that matter, might be attributed to a seasonal slump A decline during a month such as July can be taken only as another concrete indication that the public has not become sufficiently airminded or airwise to the extent of buying airplanes in any large quantities

And that brings us to the subject of 1930 merchandising Let it not be thought that this corner of the magazine is to be devoted to merchandising articles They will be contained elsewhere in the issue However there are one or two general merchandising subjects which are permissible of mention in this more or less personal analysis of industry activity

The problem of inducing the public to fly is one which has taxed the best brains in the industry. As yet it has not been satisfactorily solved On one side we hear the statement that the industry has not produced the type of airplane that appeals to the man in the street. On the other side we hear the complaint that the price holds him back and as soon as we can reduce prices plane sales will increase

Unfortunately it will have to work the other way The airplane manufacturer has got to increase sales before he can cut prices That is, cut them in accordance with the economic standards of his business Therefore, 1930 merchandising procedure will be to sell the man that has enough money We have not at present the sales volume that permits a slashing of prices to conform with limited pocketbooks And, in the opinion of many, we have not got the kind of airplane that has a unanimous appeal Thus it follows that we must sell the man who can afford the price we ask for that which we have, and which we consider to be the best at this time

The above statement is neither new nor startling Anyone who has given aeronautic merchandising serious thought has arrived at the same conclusion However, the conclusions reached as to how to sell the man with money are not similar

It has become quite the thing in aeronautics to perpetually make comparisons between the growth of the automotive industry and the aviation industry In that respect we claim to be no outsider Hence, what follows is no deviation from the beaten path

In the early days of the automobile the salesman sold his prospect three things, transportation for either business or pleasure, the modern means of transportation, and, because the prospect knew little if anything about the operation of the modern means of transportation he sold him the idea of employing someone to operate. In other words, a chauffeur As the prospect became more accustomed to the new means of transportation, he became more and more interested in its operation The result was that eventually he got the desire to operate it himself In time he got so that he would take the wheel for awhile In time improvements in design gave him the desire to operate it all of the time In time hundreds and thousands were operating their own automobiles And today the number of chauffeurs is infinitesimal a compared with the number of private operators

We fail to see much difference between the task of the early automobile salesman and the present day airplane salesman. We do see, however, the folly of endeavoring to sell a man something about which he knows very little by trying to convince him that he can pick it up in no time He, like the early automobile owner, may get the urge to pick it up later, but at present the idea of being his own chauffeur, even though it be in an airplane really doesn't interest him very much. Of course the exception is the sportsman pilot, but he is of another breed of prospect

Therefore, if there be a certain tangible relationship between the development of the automobile and the airplane, does it not sound practical to take a leaf from the automotive book? If during 1930 our general market is to be made up of people with money, why not stop selling just the airplane, and instead sell modern transportation for any use to which the prospect may deem to put it, the means of modern transportation, and a pilot to handle that modern vehicle It will be no more difficult to sell all three than it will be to sell just one of them And the result will be infinitely more beneficial to the growth of the industry

SAFETY IN FLYING

ONE particularly interesting development during recent weeks, that calls for enthusiastic support from all sides, is an airplane parachute developed by the Russell Parachute Co, and sponsored in public test by the Detroit Aircraft Corp Although dropping a plane by parachute has been tried before and with little success, the results of the test recently conducted in Detroit give every indication that another definite step toward the reduction of accident-life-loss has been, or is about to be made.

Although the plane was damaged in the landing, its pilot Vance Breese was unhurt, and later issued the statement that the landing shock was no greater than that experienced in a normal bad landing We sincerely hope that developments will be continued and the perfected product installed in every transport plane Even though the occasion never arises to make use of a plane chute the fact that it is there ready to perform

its duty in case of necessity will have a most comforting effect upon the nervous air passenger.

Yet with our praise of this new and possible air accident mortality rate reducer we add a word of caution Let us not be completely content with it as such. No one device is going to prevent accidents, or even reduce them to a considerable lesser degree than they are now It will be a combination of safety improvements which will eventually place the airplane on a high safety level For instance, a plane parachute is of little use if the plane catches on fire. It is of no use if the plane flies into a mountain side Hail, to the plane with a parachute, and a double hail to the fireless airplane and the non-mountain hitting ship!

AIR TRANSPORT TRAFFIC REPORT

SHORTLY following the long awaited confirmation of the P.A.A. purchase of Nyrba assets (which incidentally is a splendid bit of good fortune for Nyrba) comes an air transport report for the second quarter of the year It has been released by the Aeronautical Chamber of Commerce, and its sum and substance casts a very refreshing ray of sunshine upon the otherwise dark and somewhat dismal aeronautical situation in this country It seems that although manufacturers are struggling desperately to stem the tide of red ink and air transport operators are carrying on with fear and trembling lest some mystifying interpretation of the Watres Bill pops up to ruin their best laid plans, the lay-public is patronizing the airlines in increasing numbers For the first three months of the year a total of 44,931 passengers were carried And for the second quarter the total was increased to 88,074 The mileage flown during the two quarters was 4,409,791 for the first three months, and 6,315,544 for the second three Not only has there been a most pleasing increase in passenger traffic, but there has also been a commendable improvement in the percentage of scheduled miles flown For the first three months it was 79.18, 84.94 and 91.68 per cent For the second three months it was 96.50, 98.50 and 97 per cent respectively

Of course it must be taken into consideration that weather conditions during May, June and July are considerably more favorable than during January, February and March However, to offset that perhaps we have the fact that during the last three months there was a fare rate increase put into effect on some of the lines.

Regardless of all that, the fate of air transport in this country has not caused us half the thought and worry that the small plane market has It has always been our contention that the airplane is a commercial means of transportation and not a toy for those who may have the price, even if that price be very low. We believe that as time goes on there will be a profitable private market for the small plane manufacturer, but the back bone of the industry will be the transport lines that reach out in all directions, tapping the commerce and daily activities of every town and city in the country

To express our beliefs more clearly we compare the private plane business to the aeronautic industry in exactly the same way that we compare the motor boat business to the shipping industry. Of recent years the motor boat, particularly the outboard motor boat has caught the fancy of the nation, and according to reports, some handsome profits have been made by the manufacturers However, those profits gratifying as they may be cannot be compared with the profits made by the steamship companies of the world. In time the same thing will be true regarding the private plane and the air transport

Of course before that time arrives we will witness many changes in the transport airplane Somehow we feel that the air transport of the future will have very few of the characteristics of the present day craft And like the railroads it may take some time before passengers will be carried at a profit. We look for such legislation as the Watres Bill to be our salvation until then However, if with the equipment and service we have at present we can continue to build up air transport patronage, it follows that future improvements in same will see a proportionate increase in passenger revenue

The biggest problem facing the industry is how to induce the members of the general public to regard the airplane as a valuable and indispensable asset to their daily life The problem will be solved through the medium of the transport lines Therefore traffic increases, small as they may be, and teasing as they may be with regard to the possibility of ever getting into blue ink, may be taken as definite indications of progress in aeronautics The old saying that Rome was not built in a day can be applied with emphasis to our situation right now For a time we were almost believing that we would witness a millennium in industrial development, that aviation was going to establish a precedent by going to the very top in leaps and bounds. Now our common sense tells us that that could not possibly have happened. We were bound to hit the slump that did hit us

In short the growth of new development is gauged by the need of the public for that development In development we are ahead of the times As yet we have not completely or adequately convinced the public that it needs the airplane We are making progress in that task however Perhaps there is something that will come to pass to swing the tide completely over As one great captain of industry has been quoted as stating " every successful industry has a key invention which forms the line of demarkation between success and failure" A review of other industries bears out the truth of that statement. Perhaps aviation is waiting for its key invention What that key invention will be we certainly do not know Perhaps it will be an absolute method of landing in fog, or suspension in air with engines dead, or a five foot airport, etc At any rate, the key invention will probably not be long in coming, and in the mean time the progress we make in air traffic operation at least strengthens the back bone of the industry

THE 1930 NATIONAL AIR RACES

ALTHOUGH the 1930 National Air Races are dealt with in considerable detail elsewhere in this issue there is one event that took place which is worthy of mention in these columns. Particularly in view of the relation it has to what we have been writing about in the above paragraphs That was the non stop derby

The first non-stop derby on a National Air Race program was flown, or rather attempted during the Spokane meet in 1927. The race was a failure as the only two contestants were forced to land short of the mark The course was New York to Spokane In 1928 at Los Angeles the New York to Los Angeles non-stop derby was also a failure no plane making the entire route without landing However, in 1929 three of the four contestants managed to fly non-stop from Los Angeles to Cleveland.

This year the race from Los Angeles to Chicago was what one might regard 100 per cent perfect There were five planes competing, all of them Lockheed cabin jobs Four of them were powered with the Pratt & Whitney Wasp engine, while the fifth was fitted with a Pratt & Whitney Hornet engine All five reached Chicago non-stop, and the difference between the time for the first plane and the time for the last plane was 49 minutes and 37 seconds!

It is admitted that five of the best long distance pilots in the country were at the controls But when five planes can go full throttle for 1,760 miles and arrive within 49 minutes of each other we need not feel that we are slipping backward An exhibition of long distance reliability like that is proof positive of progress It speaks volumes for both plane and engine, and it was a pity that the visiting lay public at Chicago was not more impressed

And from our observations they were not particularly impressed Not because they knew all about it and considered the affair of little importance as compared to what was going on right at the field, but because they didn't have a clear idea of what it was all about That was the fault of the announcers The planes left Los Angeles at different times, and therefore there was a considerable lapse of time between the arrivals in Chicago As a matter of fact four of the pilots took off on one day while the fifth took off the next day When one of them roared across the finish line the audience had not the slightest idea who it was Sometime later it would be announced, and the

public atending would promptly forget all about it However, as mentioned in the report of the races printed elsewhere in this issue, the announcing was far from good, and we will have to be satisfied with what little worth while information was divulged to the public

COSTES' PARIS-NEW YORK FLIGHT

THE crowning aerial achievement of recent weeks was, of course the non stop Paris-New York flight by Costes and Bellonte in their Hisso powered Breguet Their flight which took 37 hours 18 minutes and 30 seconds to complete has, as one governmental dignitary so aptly put it, made the North Atlantic a two-way street

The details of the flight have been published and re-published in all the newspapers of the world There is therefore no need of repeating them here However, there are one or two points regarding the flight that got little if any mention in the daily press One is, what did the flight prove? Another is, what benefit was it to the progress of aeronautics?

As we view the accomplishment our answer to both questions is nothing. If anything was proved it was only the fact that all things being equal an open cockpit job can cross the north Atlantic from east to west, and that said plane does not have to be straight from the production line. What benefit the flight will have upon the progress of aeronautics will have to be gauged by the amount of public interest attached to the crossing However, the public will always turn out for a hero whether that hero be of the air or of the ground Of course, there is some benefit to be derived from the flight in the form of aeronautic publicity on the front pages of the press, and perhaps our pessimism causes us to underestimate the value of such publicity However, we feel that little if any benefit was received in the form of ideas for future design improvement navigation knowledge or new meteorological information

The above paragraphs may cause one to believe that we attach little importance to the Frenchman's flight That is correct, as far as the flight marking a definite step forward in aviation progress is concerned The items of skill, courage, flying knowledge and perseverance involved are things entirely apart We wish to make our voice as loud as the next in bestowing praise upon Costes and Bellonte We have always considered Costes to be the second best if not the best pilot of the post war period His latest accomplishment only serves to boost him in our esteem

However, there is a vast difference between a spectacular event that is not necessary of accomplishment, and one which although less spectacular becomes the corner stone in a progressive and nation wide beneficial development The difference between those two things is something to which we ourselves have been blind for quite some time

No matter the nature of the flight, no matter how unimportant it was to aero progress, no matter how foolishly risky it was, every successful flight has been met with shouts of praise for blazing some sort of an air trail or other The press has worked overtime to get all the hair raising details to the public Men who knew in their hearts that the flight was unwarranted made countless after dinner speeches in which they pointed out how the flight was a great step forward Innumerable firms have offered all sorts of rewards and prizes for others to shoot at. The result of all that sort of thing has merely served as an impetus to pilots to risk their lives under the cloak of progress making accomplishments

To attempt a hazardous flight is no crime Even if it has been done before, it is not foolhardy for someone else to do it What is foolhardy is for us to encourage the idea along the line of it being of any value to any one other than the person who does it As a sporting thing as a feat of daring or purely as something the adventurer desires to accomplish, it may be perfectly justified But the success is strictly personal and we should not let our tongues run astray by stating that great steps forward have been made Such a thing is misleading to our listeners

In that respect we praise Costes' flight more than we praise a number of the others It is our firm belief that Costes made that flight because Costes wanted to, and not because he believed that he was blazing an air trail to greater aeronautical progress When he reached these shores he carried on to Dallas, Tex., to win the prize that awaited him there Several people were surprised that he did that There was no occasion for surprise. Costes did not fly the Atlantic for science. He flew it for Costes and the glory of France He made no pretense that it was otherwise, and we certainly admire him for that

To those who insist that Costes' flight was a step forward in aeronautical progress we call attention to the plane he flew It is several years old In it Costes has made several no stop trips considerably longer than the distance from Paris to New York In other words, before he set out he knew and the world knew, the distance possibilities of the plane under ordinary conditions. It was not a question of whether the plane could travel the distance between the two big cities Rather it was whether Costes could get a good enough break in the weather to permit him to get through He did and of course we can not lay it all to luck The success of getting through was a combination of luck, good navigation, good radio and a born pilot The plane and engine merely functioned as they had functioned before

He made the trip in a plane that had already flown countless thousands of miles. A plane that was built years ago A design that has doubtless been improved upon already It crossed the Atlantic how ridiculous it would be to even think of converting its type into a mail plane and opening a fast mail service between the two continents

The time is perhaps not far distant when there will be an air connection between Europe and America, but we should not let ourselves believe that Costes' flight or any other flight during the last two years, is speeding up that time We have got to learn to walk before we start running And as most of us will agree, we haven't learned to walk right yet Let distance flights carry on There is always a certain lure that some cannot resist There always will be, no matter how we may strive to stem it by legislation or otherwise But let us not consider, or worse openly state, that successful repetition of a flight constitutes industrial progress Particularly when the plane used is slowly growing whiskers, good as it may be Such a flight is a demonstration of personal daring and skill. The reward should be personal also. It could not be anything else Costes is a great pilot, he has made a great flight We admire him more than ever and we sincerely hope that he will obtain the fullest measure of personal reward

THE 1930 NATIONAL AIR TOUR

AS WE conclude this months' opinions, the 1930 National Air Tour is well under way. A total of 18 planes of various makes and types are to visit some 30 cities in 14 states and 3 Canadian provinces Accompanying the contestants are 17 other planes carrying officials and guests That makes a total of 35 planes in the aerial caravan Thirty-five planes that will be inspected by thousands and thousands of prospective purchasers If nothing else the annual air touring classic of the country is a perfect advertisement for the aviation industry

In years gone by there has been some sort of dissatisfaction crop up during the Tour or following its finish There always will be that sort of thing no doubt Every industry has its prima donnas who are prone to complain at the slightest provocation However, each Tour has seemed to be more successful than the one before it Therefore perhaps it would be just as well to expect a certain amount of dissension among the contestants and overlook it in favor of the real opportunities which the Tour affords The Tour will get publicity wherever it goes What the manufacturers entered want, is prospective sales That's the main idea of the Tour It was inaugurated for that reason With aeronautical merchandising in a very bad way just at present the Tour should be cashed in on to the utmost There is no reason to feel that the Tour failed if one does not return to Detroit with a book full of orders Where the Tour will fail will be if one returns to Detroit with no names and addresses of persons who were provided with product information en route and sufficiently interested to warrant a thorough follow up

Statistics of the Month

NEW material further supplementing the statistical issue, AVIATION, March 22, 1930, is given herewith. As announced in our April 26 number (which carried the first supplement) such data will appear regularly each month for the use of those who wish to keep the curves and totals up to date. Page numbers in the statistical issue are given.

AIR TRANSPORT AND MAIL

(Page 574) Airways and Operation Mileage
July 31, 1930

Miles of mail airways	27,887
Total miles of airways	48,169
Miles scheduled daily with mails	61,785
Total mileage scheduled daily	100,687

August 31, 1930

Miles of mail airways	28,011
Total miles of airways	48,016
Miles scheduled daily with mails	68,604
Total Mileage scheduled daily	120,388

(Pages 578-6-7) Cumulative totals for the first six months of 1930 are

Total miles scheduled	8,133,670
Total miles flown	7,542,430
Lb mail carried	3,761,803
Amount paid to contractors	$6,955,848
Average weight per scheduled trip lb.	290.1
Average compensation per mile flown	$.902
Average compensation per lb carried	$1.847

(Page 584) Contract air mail regularity (Percentage of mileage flown of mileage scheduled)

June	98.7%

(Page 578) Percentage of total route mileage on which mail is carried

July 31, 1930	66.3%
August 31, 1930	63.2%

LICENSING

(Page 580 and 580) Periodic Airplane License and Identification Data
August 30, 1930

Licenses valid	6,850
Identifications valid	2,371
Total licenses and identifications	9,151
Ratio of licenses to total	0.752
Number of airplane pilots licenses valid	14,812
Number of glider pilots licenses valid	203
Number of mechanics licenses valid	8,038

New pilots' licenses issued during August, 1930

Private	622
Industrial	1
Limited commercial	35
Transport	24
Glider	84
Ratio of licensed pilots to total planes	1.664
Ratio of licensed mechanics to total planes	.87

AIRPORTS

(Page 592) Airport statement

	Jan 1	July 1	Aug 1
Municipal airports	453	500	506
Commercial airports	495	556	560
Intermediate fields	285	306	308
Auxiliary fields	235	210	217
Government airports	84	81	80
Total airports	1,552	1,653	1,671

MISCELLANEOUS

(Page 598) Civil Aviation in the United States. It is now possible to eliminate two of the estimated figures appearing in this tabulation, and insert the correct totals. They are:

Airplane miles flown, all operators	25,141,498
Passengers carried on transport lines	173,405

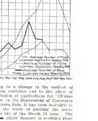
EXPORTS

(Pages 504 and 506) Detailed export data for July were published on page 8 of the September 6 issue of The Aviation News. Cumulative figures for the first seven months of 1930 and, for comparison, the first seven months of 1929, together with the percentage of increase or decrease between these two comparative periods are given below.

	1930	1929	Difference Per Cent
No. of aircraft	199	218	−8.7
Value of aircraft	$3,256,386	$3,598,395	−9.4
No. of engines	288	256	12.5
Value of engines	$985,773	$987,479	−0.2
Value of parts	$1,335,692	$1,294,261	3.1
Total value of exports	$5,577,451	$5,920,155	−5.0

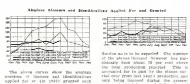
Apparently the year 1930 will not continue the steady rapid growth of exports that has marked the last four years. The decline in total export business from last year however is very small. Taking into account the sharp drop in production for domestic consumption the proportion of the aircraft industry's trade that is going abroad is much greater than at any previous time. Up to the present time the total value of exports (aircraft engines and parts) is 5% lower than it was for this same period last year. The only items to show an absolute increase over the first seven months of 1929 are the value of aircraft parts (and this increase is very slight) and the total number of engines exported. However there has not been a relative increase in the value of engine exports. The average unit value of the engines exported has decreased somewhat although the average unit value of the airplanes has remained approximately the same this year as it was last.

Pilot Licensing



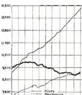
Owing to a change in the method of preparing statistics and to the effect of the inclusion of applications for "Change of Class" in the Department of Commerce pilot license data, it has been desirable to change the basis of plotting the curve on page 561 of the March 22 issue. The curve on pilots' licenses is modified from January 1 of this year. Prior to that date the figures remain as previously given in our statistical issue, but henceforth, the average number of licenses granted each week instead of numbers applied for will be the basis of tabulation. It appears that this change made very little difference prior to the end of last year and the three curves therefore can be taken as almost strictly comparable.

Airplane Licenses and Identifications Applied For and Granted



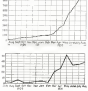
The above curves show the average numbers of licenses and identifications applied for or (in 1930) granted each week. The heavy dash-line on the chart with the licensed aircraft indicates the average weekly production of aircraft during 1930 as reported by the Aeronautical Chamber of Commerce. The two curves for 1930 run parallel with each other in general, changes in the trend of the license figures taking place at a somewhat later date than in those for production as is to be expected. The number of the planes licensed however has persistently been about 70 per cent above the total production reported. This is accounted for in part by the planes carried over from last year's production and only being licensed during the present season, in part by repeated licensing of the same plane after modifications of the original certificate, in part by the issuance of licenses to manufacturers not participating in the production report of the Chamber. This last, however, is a small item, as all of the important manufacturers holding A.T.C.s has been submitting production reports to the chamber.

Valid Licenses and Identifications



Licenses and identifications in force week by week (not including gliders) together with the total number of licensed pilots and licensed mechanics. During August the total number of licenses and identifications valid reached the lowest level since before October, 1929, but rose sharply at the end of the month.

Glider Licensing and Identification



Top curve. Record of glider identifications and licenses valid at the end of each month. The week ending August 30 marked the beginning of glider licensing. At the end of that week 19 gliders were listed as having been given license numbers.

Lower curve. Average number of glider identifications granted weekly.

FACTORY DATA

(Page 561) With the release of the Census of Manufacturers data for 1929 it is now possible to fill in the blank spaces in the Summary of Aircraft Manufacturers Census for the United States. The figures given in the statistical issue for 1929 were as of May 31, 1929, at which time aircraft factories were running at about their maximum output. The figures below are as of December 31, 1929.

Number of establishments	117
Wage earners (average for the year)	9,888
Average number of wage earners per establishment	84
Wages	$15,804,827
Average wage	$1,603
Cost of materials, fuel and purchased electric current	$24,719,846
Value of products	$61,973,079
Value added by manufacturer (value of products less cost of materials, fuel, etc.)	$37,253,233

FOREIGN CIVIL AERONAUTICS

The following data will fill in many of the remaining blank spaces remaining in the tables on foreign activities. All information is for the year 1928 unless otherwise indicated. (Page 601) Statistics of Civil Air Transport

Australia

Total number of civil aircraft	211

Austria

Miles of airlines in operation	2,232

Belgium

Miles of airlines in operation	2,032
Passengers carried	5,264
Lb of mail and express carried	510,000
Total number of civil aircraft	33

Czechoslovakia

Passengers carried	12,485
Lb of mail and express carried	1,535,392
Number of aircraft in transport service	59

France

Miles of airlines in operation	17,288
Passengers carried	100,114
Lb of mail and express carried	3,793,696
Number of aircraft in transport service	361
Total number of civil aircraft	934
Estimated production of aircraft	2,400

Germany

Miles of airlines in operation	16,980
Passengers	111,134
Lb of mail and express carried	5,031,220
Total number of civil aircraft	971

Great Britain

Miles of airlines in operation	8,305
Passengers carried	28,289
Lb of mail and express carried	2,070,489
Number of aircraft employed in transport service	28
Total number of civil aircraft	680

Poland

Passengers carried	14,432
Lb of mail and express carried	467,012

(Page 602) Percentage of Regularity

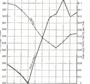
Great Britain

Percentage of scheduled trips completed	92.0%
Percentage of started trips completed	98.9%

(Page 602) Annual Airplane Mileage in Air Transport (for 1928)

Czechoslovakia	310,192
France	5,859,405
Great Britain	1,189,240
Poland	827,736

Airline Fares and Passenger Traffic



The accompanying curve is a continuation of the survey of airline fares and passenger traffic which was published in the August, 1930, issue of AVIATION. The trend of passenger traffic and average rates charged per passenger mile during the past two months has been added to the original curve in order to show the recent developments.

The reports used were from a select group of companies operating lines which cross many types of terrain and operate under a variety of seasonal conditions. They may be considered as a fair sample of all airlines now in operation with the exception of the lines of a pure winter resort type. The final figures used in drawing the patronage curve are weighted means, with each line given a weight proportionate to its total traffic. The rates plotted are the weighted means of the charges maintained by these same companies during each month.

January was chosen as the base-line in rating the mean passenger traffic and was given an index number of 100. During July the effects of the increased rates caused a sharp decline in passenger traffic. During August, the upward trend in the passenger traffic curve appeared anew, bringing the index back above the May level. However, it is not to be expected that the rapid increase of passenger traffic will continue much longer. The usual seasonal decline will soon begin, although lowered rates and an extended habit of air travel no doubt will prevent as serious a drop in passenger traffic as has formerly been experienced.

(Page 602) Express and Mail Traffic in Ton Miles

Great Britain	345,490

(Page 602) Passenger Traffic in Passenger-Miles

Australia—1927	412,671
Australia—1928	645,200
Australia—1929	1,032,257
Great Britain—1929	7,120,603

(Page 603) Number of Aircraft Registered

Australia—1927	64
Australia—1928	122
Austria—1927	24
Austria—1928	27

(Page 603) Accidents

Great Britain

Passenger fatalities per million passenger miles	1.85

AFTERTHOUGHTS ON THE RACES

By Edward P. Warner

Editor of AVIATION

IN MAKING critical comment on an aeronautical event it is convenient to draw a sharp line of division between policy or general plan and its execution. In judging of the success of a race meet, we have to ask ourselves two questions. First, what were the races designed to accomplish, how were they intended to accomplish it, and was the end a worthy one? Second, were they well run?

Upon the first point there is room for a limitless difference of opinion, for hardly any two people will agree upon just what is a worthy object. Is it intrinsically helpful that aviation should be kept on the front pages of the newspapers? Is it desirable that people should gaze open-mouthed at airplanes? Should all competitions held be so simple in their rules and organization that they can be explained to a miscellaneous audience in a few sentences from a loudspeaker? Are the National Air Races intended to appeal primarily to the aircraft industry, to amateur competitors, to the general public where they are held, or to all the newspaper readers of the United States? The writer has his own answers to those questions. Practically every reader will do the same.

Upon the second factor there should be no question. Good management is good management and is always recognizable. It should be as easy to pick out executive work deserving of extraordinary commendation as to recognize flaws of omission or commission on the part of the organization.

The Personal Appeal

AT Chicago, as at Cleveland and Los Angeles, the general plan revolved entirely around a determination to catch the crowd. The local advertising had been excellent, and local interest had been sedulously tended to a high pitch. The publicity before and during the races, as well as the actual program of each afternoon's events, was focused upon the displays to be given by famous flyers. "People," says an axiom of the newspaper business, "want names." The anticipation that Lindbergh will arrive from some distant point, circle the field and land and be escorted to the judges' stand, is still good for thousands of extra admissions. The lay public undertook the lengthy trek to Curtiss-Reynolds airport to see for themselves, even though at rather long range, the men who had been filling the headlines in their papers. The names of Frank Hawks, Jimmy Doolittle, and Al Williams had been household words, and they needed no advance advertising. Skillful publicizing supporting a natural press interest had developed for Doret, Loose, and other European participants' reputations something like those that they had in their own countries. The services, of course, have a prestige of their own with the crowd without the necessity of exploiting individuals, but they have added to it by giving a collective personality to such picturesquely named groups as the Sea Hawks, the Three Musketeers, the Fireflies, or the Unholy Three.

So far as public interest and publicity given were concerned, the races themselves, with the possible exception of the Thompson Trophy Race, were an afterthought. On that point those who, like the writer, believe that the

No organization is so perfect that its workings can be exactly foreseen. No one could tell just how the Air Races would go until they were over. It then becomes appropriate to make a critical study of the Race Meet, both as a matter of general interest and as a guide for planning similar events in the future. Such a critique on the Cleveland Races was presented in AVIATION for September 28, 1929. This article is a similar study of the events at Chicago.

National Air Races should be what the name implies will score their first serious complaint. The air races become more and more emphatically a stunting show. In the past, that has been accepted as inevitable on the theory that races themselves could not be made attractive to a crowd. The Chicago meet came so near to making them attractive and exciting, and the reasons for the failure to achieve complete success were so obvious, as to shatter that theory. The Indianapolis Speedway draws a capacity crowd on every Decoration day, and has done so for nearly twenty years, to see an event that is intrinsically dull beyond belief. They do it without putting on any games of auto-polo or any loop-the-loop festivals as relief to a steady five-hour parade around a brick saucer. Air racing can be made more interesting to the non technical onlooker than any automobile race. All that is wanted is better management and better publicity work.

Let it be emphasized again that in these respects Chicago marked an enormous advance over either Los Angeles or Cleveland. The criticisms that had been made in other years were carefully taken to heart by the responsible officials in Chicago, and every effort was made to avoid repetition of the same mistakes. The endeavor was about 80 per cent successful,—and to be able to put it as high as that is really strong praise. If future contest committees build on Chicago's experience in the same way, we should very soon have races that are capable of carrying themselves without having to depend on the Army or Navy or the gyrations of civilian acrobats to furnish public appeal. That optimistic prophecy runs counter to the convictions of some of the best showmen in the business, but we again offer Indianapolis, and for that matter a variety of other sporting events, in evidence.

Race Management

THE first thing needed is of course a better and more personal publicity. If pilots already "famous" in the headlines will themselves enter in the races, so much the better. If not, some advance effort should go into telling the public something about those that do compete and into "building up a personality" for them. Mrs. O'Donnell, Mrs. Omlie, John Livingston, Verne Roberts, Leroy Manning, and many others should be good for any amount of public interest and newspaper attention if their stories are properly presented.

The next consideration is that the races should be intrinsically exciting, and it is there that Chicago made the greatest progress over all its predecessors. So far as the spectator is concerned, there can be no such thing as a race if the contestants all start at different times and chase each other around the course in an endless procession. The "race horse" start eliminated that trouble once and for all. Incidentally, the name is a little unfortunate as it suggests, at least to those who are not followers of the track or who are familiar with trotting rather than with running races, a start in full motion, whereas the time was actually taken from a standstill at the instant when the starter dropped his flag. There have been alarming prophecies about the possibility of accidents from several machines started simultaneously. They

A broadside view of the Chicago crowd

proved unjustified E. W Cleveland in charge of general operations at the starting point and Ray Collins controlling the actual alignment of the machines and dropping the flag kept everything running smoothly There were no crashes and so far as the writer could observe no near-crashes, from that cause The introduction of a scattering pylon changes the length of the course and distorts the apparent speeds, but these races are not run to make records, and speeds on the first lap from a standing start have little significance in any case If a measure of the performance of the airplanes is desired, it is better obtained by taking averages for the remainder of the course, with the first lap excluded The speeds quoted from Chicago were a little misleading in any event unless carefully interpreted, for it was not generally realized that the "five-mile" course had deliberately been made 834 ft or three per cent short The object was to make approximate allowance for the extra distance covered in rounding the pylons, so that the calculated lap speeds in the races might be close to the normal straight-away maxima for the machines

The simultaneous standing start for all competitors was considered too hazardous in the Thompson Trophy Race and they were sent off at ten-second intervals In such a case it would seem better to limit the number of competitors very definitely to put a scattering pylon three or four miles away if necessary, and to use a flying start with the planes lined up on a non competing machine as a guide That is quite as practicable a type of start for fast airplanes as for automobiles, motor-boats, or trotting horses all of which score down to the line keeping approximately abreast and go over on the drop of a flag In fact a little experimenting might well be undertaken to determine whether or not the simultaneous flying start should be substituted for the standing "race horse" type in all events With proper cooperation from the pilots in keeping abreast up to the starting-line, it could be made both fair to the competitors and very exciting for the audience

Short Courses and Short Races

ANOTHER very helpful innovation was the shortening of the races and the use of the five mile course throughout The course was too small for the Thompson Trophy Race where the making of so many turns in such rapid succession in fast planes imposed an unfair and dangerous strain on the pilot but for all the stock plane events and indeed even for the free for alls of the smaller classes, it was ideal There was some suggestion that the course should have been laid out so that the audience could have seen more perhaps in rectangular shape with a short leg across the field and a turn made in front of each end of the grandstand, but it is very difficult to improve on the present form without running the risk of having the machines drift over the stands as they turn, if (as is usually the case) pilots misjudge the pylon and start to turn too late and swing far past it The one had mistake in layout as seen in retrospect and as was tragically shown by Lieutenant deShazo's accident was the extension of the stands around to a point where planes normally passed over them on finishing a race

There is no particular reason why large airplanes should fly a longer course than small ones merely because they are able to carry more gasoline The transport machines were sent ten laps while nearly all the other events were confined to five The shorter distance is quite enough for any type of plane, and in fact it might even be cut to three with profit in some cases No race need last over fifteen minutes, and ten is about the ideal In only about two cases in the last four days of racing were there changes in position among the leaders after the third lap of a five-lap race, and those were due to the eventual winner having got away to a poor start If the flying start were used, three laps would certainly be sufficient

It is of no importance that a large number of starters be secured to make an air race interesting but it is important that the event be well contested Two machines keeping close together all the way around the course are more interesting than a dozen strung out at wide intervals The ideal is from three to five planes, and where there are more than five starters preliminary heats might well be resorted to To encourage close finishes among machines of varied types, handicap events, which have been used with such extraordinary success in Great Britain but have been persistently neglected here should most certainly be introduced It was suggested by Major Schroeder that in the future a series of handicap races might well be run, with the same entrants on each day, the starting times for the first day being arbitrarily assigned in the handicapper's judgment and being readjusted every day thereafter in the light of the results secured in the previous heats With the accumulation of data in the hands of the handicapper finishes would grow steadily closer and the races steadily more exciting as the meet neared its end

A strip from the official chronograph showing the recording of the passage of four machines The first for example at the bottom of the sheet crossed the line at 41 min 4 40 sec after the hour

An innovation at Chicago which again paralleled, although it did not actually imitate, British practices, was the introduction of a freak medley race The contest in which amphibions were required to fly from the field to the lake, land there and pick up a dummy and bring it back to the field, had some special technical interest, and was entertaining both for the competitors and for the spectators While the gymkhana element should not be allowed to run away with the straight speed contests, it may well be extended a little farther than at Chicago

That is the credit side of the ledger On the debit side the outstanding items are the announcing which was appalling and the old grievance of lack of score cards

Loud-Speaking Deficiencies

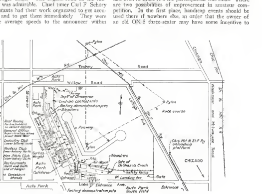
UP TO the last two or three days, when a certain improvement was manifest the announcer seemed to be both uninterested in the races and almost completely ignorant of what was going on One of the gentlemen who labored at the microphone suffered from the affliction common among the members of his profession, of over-rating his own standing as a humorist On at least one occasion the announcer did not even mention a race or take note of its existence until it was about half over The loud speakers were kept busy pouring into the audience's ears the current baseball scores, the information that "Mrs ——— wants her husband and wants him now " such personalia as "Mr ———'s baby boy has arrived at the hospital" and the like They were used also for extolling the unique virtues of somebody's cheese and somebody's beer and for giving imitations (not announced as such) of how Mr. Graham MacNamee would act if he saw an airplane stunting. At various times during each day the microphone was turned over to specially qualified individuals who knew what they were talking about, and managed to be informative and entertaining without being silly. Lieutenant Chourré described the Navy's maneuvers each day Lieutenant Ennis did the same for the Army and Alford J. Williams told the audience what was going on when the foreign pilots were in the air. It might have been a good idea to get someone who knew something about the races to handle those, broadcasting a running account of what was going on, with appropriate comments on the speed being made, the manner of flying the course, and the characteristics of the various airplanes and the histories of the pilots involved The failure to do that, in fact, transcended all other lapses in the actual race management Those whose recollections of National Air Races runs back to Dayton in 1924 and the announcing of Louis G. Meister have been wondering ever since why he is not called back into service at the microphone during competitive events

In the past the excuse could be made that the announcers were unable to get information from the timers until it had passed into the category of ancient history. That difficulty might have been overcome by using unofficial timing with a stopwatch for the purposes of securing broadcasting material, but in any case the excuse no longer exists The organization of the timing this year was admirable. Chief timer Carl F. Schory and his assistants had their work organized to get accurate results and to get them immediately They were able to give average speeds to the announcer within three or four minutes after each machine had completed each lap, and if only times instead of speeds had been required (which would be more useful for a running account of progress) they could have been furnished almost instantaneously. The timing was done with a simple chronograph which printed the time on a paper type, a sample of which is reproduced with this article The delivery of the data to the public was interfered with only by inadequate telephone communication between the timing stand and the announcer's post and by the announcer's delays in making use of the figures after he had received them.

Score Cards Missing

THE second soft spot in the race management was the absence of score cards. In that respect also there was progress over the meets of 1928 and 1929 At least the occupants of the press stand could find out who was running in a race this time. A very efficient mimeographing service provided them with lists of entries for each event at the beginning of the afternoon It would have been a very simple matter, and would have taken very little longer, to print a few thousand similar lists each day and distribute them as supplements to the souvenir program. Those who lacked access to the press stand had no possible means of finding out who was who, except as the announcer occasionally undertook to inform them (not always correctly).

One of the great disappointments of the week was the collapse of the sportsman pilot events. With two exceptions they had to be called off for lack of entries, and even in those two the participation was small There are two possibilities of improvement in amateur competition. In the first place, handicap events should be used there if nowhere else, in order that the owner of an old OX 5 three-seater may have some incentive to



The layout of Curtiss-Reynolds Field for the races (taken from the official program) The location of the course is not shown with perfect accuracy, the home stretch actually running more nearly parallel to the grandstands than here indicated

enter against the proprietor of an Inland Sport or a Monocoupe without feeling that he is resigning himself to hopeless defeat. Secondly, there is no reason to have special races for "sportsmen" and leave the sportswomen out. Until such time as private competition is sufficiently developed to permit of the organization of separate contests for the two sexes, they should be allowed to race against each other.

The absence of score boards was another regrettable feature from the point of view of those who really want to follow the races closely, but we have become partially resigned to that through experience. Admittedly, a board partially interrupts a view of the field unless it be placed at the back of the stand, and in that case most of the audience never discover its existence. Individual score cards and really good announcing will at least reduce the need for the boards.

Bright Spots in Management

THESE are points of detail, but of vital importance. Looking at the carnival in more general terms, the control was divided between the redoubtable Clifford Henderson, who ran it as a show, and Maj. R. W. Schroeder, of the Curtiss-Wright Flying Service, who ran it as a flying field. Each of them, with the branch of the organization that he controlled, functioned splendidly on the matters that lay clearly and wholly within his sphere. It was on the border line between the aeronautical aspects and those of showmanship, in connection with such matters as the radio announcing and the determination of who was to be let onto the field and how, that trouble was most likely to occur.

The control of flying operations, after some hitches in the early days when it was being worked out and when many pilots were arriving at the field from a distance without having acquainted themselves with the local rules, was admirable. As director of flying, Major Schroeder stood in an elevated tower attainable only by a ladder steep enough, and through a manhole small enough, to discourage casual visitors. With a view of every part of the field, with switches for cutting on the lights that signalled when take-offs might be made, with a bank of telephones around him to communicate good news or bad, with a radio operator in constant communication with the observers at the pylons and with radio equipped automobiles ranging around the surrounding country, and with a master switch to cut in his own microphone to permit him to interrupt the regular announcer in full flight and talk to the crowd himself.

Showmanship and Press Relations

THE show was also well run as a show. We have come to take that for granted in the last three years. "Let courtesy be shown" was again the motto. It was again an instruction, not merely an advertising slogan. While the ushers and other staff perhaps fell a trifle below the standard at Cleveland in efficiency and attentiveness, they certainly left very little opportunity for unfavorable criticism. The press relations, which were this year under local direction instead of being handled by a national organization, and over which Samuel T. Moore directly presided, were splendidly worked out. Never have the physical facilities for the press been so good, and never has so much information been provided so quickly after the conclusion of the events to which it related. The press stand contained the usual fringe of friends of friends of the management and other people of the indeterminate journalistic connections or none at all but they were much less numerous and oppressive than at most past meets. No precautions were spared in making sure of the possession of proper credentials, and at times it was necessary to show a press brassard at the bottom of the ladder that led to the press deck of the grandstand and again at the top some fifteen feet away.

The system of badges and brassards functioned least satisfactorily for admission to the flying field. At one approach to the field there would be stationed a uniformed guard demanding one kind of credential. At another entrance a few hundred yards away, another type would be required, while sufficient prospecting might uncover a gap in the fence with no guard and no ticket inspection at all. At times a considerable group of spectators invaded the field, especially after Captain Page's accident, when there was a veritable stampede.

In recounting the lessons of the Cleveland races I mentioned traffic control first. It is being relegated to the last position in the present article, but it remains a factor of great importance in fixing a pleasant impression of the day in the minds of the crowd. The problem was less acute than at Cleveland, because of the great distance of the airport from the center of the city and of the excellent highway approaches and rapid transit facilities not far away, but it was still a problem and it was very well cared for. Congestion was almost unknown, and the roads were quite adequately posted with markers indicating the way to the field. By private automobile with a bold and energetic driver the grandstand could be reached in forty-five minutes from the downtown hotels. By public conveyance it took about an hour. For those who were lucky enough to be invited to ride in the Standard Oil of New Jersey's Sikorsky or in one of the other amphibious parked on the field, only about fifteen minutes was required,—but it was sometimes necessary to wait a good deal longer than that for the field to be opened so that a take off was permissible.

In summary, those who think the function of the National Air Races is to excite the public can count the Chicago show a distinguished success, and make only very minor criticisms. We who believe that the stunting element should be subordinated and that the racing should be the real attraction, on the other hand, will feel that great progress was made in the details of management but that the general policy was wrong. It may be that no future board of management will have the courage to try to get along without any stunt or exhibition element at all, but if the two things must continue to be combined, both factions in the audience can be better satisfied by dividing the afternoon more sharply between them. Let the day's races be run first, one after another in rapid succession. Then put the stunting program on afterwards. The individual interested in aeronautics can then choose for himself what he wants to see, and the casual spectator who comes to be thrilled and knows nothing of either the planes or their pilot will be on hand for the powered dive in formation and the outside loops without sitting through the closed-course contests. Furthermore, from all points of view, pro stunting or anti-stunting, the program is now too long and too repetitious. With acrobatics eliminated, the three days of the Labor Day week-end would cover everything nicely. Even with stunting maintaining its present place, a five-day meet should be ample.

THE EXECUTIVE GOES CROSS COUNTRY

A straight-from-the-shoulder account of conditions found at airports during an extended business trip by air

By Edwin G. Thompson

*President, Thompson Aeronautical Corp.
Vice-President, Thompson Products, Inc.*

IT IS the general opinion of nearly every aircraft manufacturer that the greatest potential market for the small cabin airplane is among private owners and industrial concerns, the latter because of the advantages claimed for the airplane over other forms of travel in enabling executives to keep in personal contact with their branch offices. Consequently, from the designers' drafting board, through the production, sales, service and all other departments, to the president's office, the maximum activity of all is being directed toward developing a plane which will meet every demand of the present and future owners.

In the meantime, however, there are other factors which are being overlooked and will tend to retard the growth of corporately owned planes for executive use unless remedied promptly. I can best illustrate what I mean by setting forth some of the conditions provided for handling the transient flyer, that I found at 24 airports while on a recent trip throughout the middlewest, southwest and west.

The primary purpose of my trip was business, although an equally important reason was to study facilities provided at the leading airports throughout the western half of the country for servicing the planes of itinerant flyers. I was particularly interested in learning just what conditions a business executive would meet who employed an airplane for keeping in personal touch with the branch offices, representatives or plants of his company.

The circumstances under which I made this trip were propitious, except in several instances, which I shall point out later, for meeting and studying the actual conditions the business man will meet on a cross-country flight.

I had but three weeks in which to visit our distributors in thirteen states. Therefore, it was necessary to employ a plane and travel on a pre-arranged schedule that was worked out before I started. It was so arranged that I would be back in Cleveland at our home office, within the time limit.

The plane was a six-place Stinson Detroiter, fitted with a 200-hp. Whirlwind. Thus it can be seen that in addition to the length of time I was permitted to be away from the office, the plane, engine and other conditions made my trip almost analogous with that nearly any executive will experience on a similar journey.

There was but one way in which conditions favored me. At several of the airports visited, the operators of aero repair depots had been notified by wire the hour we were expected, and they were on the lookout for us. Also, I believe my position as president of the Thompson Aeronautical Corporation, won me many courtesies.

Flying with me was one of our most experienced pilots, Edward L. Preston. We departed from Cleveland at noon, Sunday, March 16, in order to spend the night in Saint Louis and be on hand for an early appointment Monday morning. We arrived back in Cleveland Friday afternoon, April 4.

IN the course of our trip I visited as many as three airports in one city. The reason for this was, of course, to observe just what facilities were available at each for the transient flier traveling as I was traveling.

Of the 24 airports visited, only eight were equipped to, and actually serviced our plane in a prompt, efficient manner—such as I believe the transient flier, whether on business or pleasure, has a right to expect. The equipment and attention received at five others might be classed as fair. The service given us at the remainder was very poor.

Here is an example of the treatment accorded us at one airport.

It was our custom, before landing at a field, to circle about and pick out a likely looking hangar where we might have our plane and engine checked over and take on gas and oil. At the particular airport in mind, we noted a hangar with the word "Visitors" painted on the roof in large, vivid letters. This seemed a cordial invitation and we felt quite certain our treatment would be most courteous and prompt.

We landed, taxied up in front of the hangar with the word "Visitors" on the roof, and revved up our engine to attract an attendant. No one came out. We revved the engine up again, without success in attracting the attention of anyone. We revved the engine up a third time, but apparently there was no one in the hangar.

I then climbed from the plane, determined to have a look around and see if I couldn't locate someone. Back in the rear of the hangar I found a mechanic, seated with his feet on a workbench, reading a popular thrill

story magazine He looked up as I approached but made no move to see what I wanted. When I requested gas and oil, he went about his work in a dilatory manner and with apparently an utter indifference as to whether we ever visited his hangar again or not.

In all we lost nearly three-quarters of an hour at this one airport in taking on fuel and oil This service should not have required more than half this time at the most

One other illustration will give you a view of conditions encountered at a number of the fields

Upon landing we taxied up in front of the hangar we had picked out from the air as being perhaps the best on the port for our purpose Then we followed our practice of revving up the engine to attract an attendant We repeated this several times but without success We then moved up to another hangar, revved up our engine two or three times, as in the first case, but again we failed to attract an attendant We taxied down the whole row of hangars—seven in number—repeating the procedure of revving up our engine in front of each one But this appeared to be a deserted airport

Finally I climbed from the plane and went in search of a mechanic or attendant And I did a lot of wading through mud before I at last located a man who could help us At this airport we lost fully a half hour more than we should have.

At a third field it is possible that we might have gone unable to secure gas and oil and have our plane gone over had it not been for my position as head of a transport company in the industry There were but four hangars on the field Three were owned by private interests or small sight-seeing and taxi-hop operators, who had no facilities for servicing planes or motors The fourth was owned by a large passenger and mail transport operator.

I requested the services of a mechanic at the latter to inspect my plane thoroughly and have it completely gassed and oiled The manager of the base informed me that this would be impossible as they were permitted to work only on company planes

I then made known my identity The service requested was granted But they were very particular to impress upon me the fact that it was only because of my connection in the industry that I was granted this favor The manager of this hangar informed me also that his company felt transient business too unimportant to bother with (Yet, I observed that the men on duty there were standing around idle, seemingly with no work to keep them busy)

Only in a few rare instances were there attendants at the airports waiting to welcome us as we taxied up the field after landing In most cases one received the impression that the transient flier is unwelcome because he is left to shift for himself and shown very few courtesies.

Excellent airway maps were available at a majority of the airports But nearly every field lacked the appurtenance for supplying the pilot with up-to the-minute meteorological information. A number of the ports depended for this information on weather maps of the entire country, mailed to them daily by the United States Government Weather Bureau Others have only a wet and dry bulb thermometer and wind vane At only eight did I find the ports equipped with anemometer, a sheltered wet and dry bulb thermometer, a recording barometer, a phaedolight, for determining the ceiling, a wind vane, a rainfall gauge and the other instruments essential in securing a complete picture of local meteorological conditions Thus we were often forced to be our own prophets and guess what sort of weather we would encounter before reaching our next port of schedule

Aside from the factors at the airports which pertained purely to flying, there were other things lacking at a majority of the fields which make the journey of a cross country flyer as much a hardship as a pleasure

Inadequate comfort facilities for flyers and passengers were very noticeably lacking at the ports visited At some fields there were none at all One of these is a schedule stop for a large passenger line At others everybody depended upon a single rest room Only a scant half dozen had the facilities one would expect to find at a modern airport

The inconvenience of traveling downtown from the airports was felt In very few instances was transportation available at the fields We found it necessary to waste considerable time sitting around hangars, while waiting for taxicabs to come from town to take us back Only in one instance was a real service available A branch of a Drive-Your-Self system was located at the airport

A number of other minor factors were noticed which must tend to discourage the executive, salesman, or itinerant from using his own plane in traveling across country—if they experienced the same reactions as I did

Had we found it necessary to have any work on our plane or engine, other than replacing a spark plug, tuning the ailerons and other minor jobs or had weather conditions been anything but almost ideal during the whole trip, I would have been unable to complete my journey in the allotted time However, with conditions as they were it kept me moving almost constantly to complete the trip in the time allowed But I was unable to spend as much time with our distributors as I should have

The preceding paragraphs may make it appear that I am thoroughly discouraged with cross-country flying and would hesitate to use my own ship again in a similar trip Frankly, I was very much disappointed in the conditions as I found them But—because I am more familiar with the problems the industry has been facing than the average man who might be using a plane on business—I am inclined to be more lenient

Since my trip, however, I am more convinced than ever that the airplane will play an extremely important part in carrying business executives and salesmen over their territory in the future Salesmanagers and others who are required to do considerable traveling throughout an extensive territory will find a company owned plane both efficient and practical for the purpose—after a number of present conditions are bettered

Prompt, efficient and courteous service, which can be secured almost everywhere, has been the keystone on which every manufacturer of a mechanical machine or implement has built his success Automobile manufacturers who neglected to establish a network of well equipped dealers and service garages throughout the country failed to survive, or they were slower in achieving the success attained by those who first developed such a net work The same will be true in the aviation industry unless conditions are altered

It is up to the aviation industry as a whole to remedy present conditions The panacea is simple and obvious: greater facilities and more efficient and courteous attendants!

DESIGNS AT THE NATIONAL AIR RACES

Airplane designs, particularly those of the contesting machines at the Chicago National Air Races, showed little originality, most of the designs being developed along the same lines as previous racing craft. There were however, a number of technically interesting aircraft to be seen on the field at various times.

By Leslie E. Neville
Technical Editor of AVIATION

WHENEVER a large group of airplanes is gathered together, there is an opportunity to make observations of their type and technical features in an effort to determine the tendencies in aircraft design. While no attempt is made in this article to make a numerical study of the group because of its constantly fluctuating numbers, random observations of some of the more interesting machines are presented.

Airplanes at the National Air Races usually fall into three general classes contestants, demonstration machines of unusual design, and visiting planes Of these, we will be concerned mainly with the first two groups because of the fact that the last category is usually a representation of conventional types

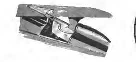
Considering the contesting planes as a group and particularly those participating in the Thompson Trophy Race, it is interesting to note that, although attempts at efficiency and high speed seem to have been made in the direction of the monoplane, the actual winner was a biplane The use of a minimum of wing area and a tendency toward the extremely thin wing section, notably the M series, are the principal characteristics of the contesting planes as a group

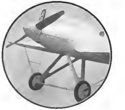
One of the interesting developments brought about by the extensive use of low pressure tires or air wheels, is a change in the general form of landing gears which is occasioned by the fact that in many instances no shock absorbers are employed with the use of these tire units The new landing gears which were seen on many of the contesting planes, suggest in general appearance the old cross or straight axle type of a few years ago One of the principal disadvantages, that of the necessity of shock absorbers, being eliminated by the use of air wheels, it is possible that this landing gear form may come into general use again In most planes, the cross axle was appropriately streamlined with the object of providing additional lifting surface, and supported at the ends by vee struts attached to the fuselage

The need for cockpit enclosures in the high speed airplanes has been met by a number of sliding windshields of the type used in the Lockheed Sirius and Travelair S airplanes Cowlings of the N A C A and Townend ring types also were employed in large numbers

A typical group of airplanes on the field at the Chicago races

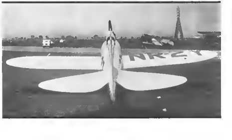
Above: The Laird "Solution" powered with a Pratt & Whitney Wasp Junior engine Below Details of the sliding windshield of the "Solution"





Above: Typical faired cross axle landing gear as employed on the Gipsy powered Howard Special monoplane Below Rear view of the Howard plane showing the high degree of streamlining of the fuselage

Above: Landing gear, slots and external wing bracing of the Warner powered McDonnell "Doodle Bug" as it was presented at the Chicago races



Left Closeup showing landing gear and wing radiator of the Curtiss "Hawk monoplane" entered in the National Air Races Right: A front quarter view of the plane which was powered with a special "Conqueror" engine

As usual supercharging played an important part in the winning of some of the races

From the standpoint of novelty there was nothing comparable to the Travelair mystery plane of the 1929 races There was, however, an increased proportion of low-wing monoplanes participating in the scheduled events, indicating a tendency toward this type in the design of high speed craft Probably the most interesting part of the program was the group of airplanes constituting the demonstration class, notably the Waterman variable wing plane, the McDonnell "Doodle Bug," and the three autogiros These unusual craft were put through their paces daily as a regular part of the program

THE Waterman machine is a normal low-wing cabin monoplane except for the method of mounting landing gear and wing panels The landing gear tread is usually wide, being 13 ft in a 40-ft span, and the wheels are mounted rigidly to the wing panels, and enclosed in streamlined fairings Wing panels are hinged to diminutive stub-sections with the hinge line set at an angle of about 25 deg. to the lower longeron in the horizontal plane The wings are freely hinged so that the dihedral and incidence can be changed, the incidence change resulting from the angularity of the hinge line External wing struts are of the inverted V type with Gruss shock absorbing units incorporated in such a way that the landing shock is absorbed at this point The position of the wing panel, with reference to the fuselage is controlled by compressed air furnished by an engine starter of the Heywood type together with the necessary tanks. An eight inch travel is provided in the shock absorber units and the dihedral range is from 0 to 15 deg The incidence ranges from $+3\frac{1}{2}$ to $-1\frac{1}{2}$ deg In addition to certain advantages expected from changing the position of the wing relative to the fuselage, the inventor claims a condition of automatic lateral and longitudinal stability

In connection with the variable wings, a landing skid somewhat suggestive of war-time European practice, has been developed This skid is hinged and fitted with a shock absorber unit at its rear attachment It is to be used in conjunction with the wing in landing As soon as the plane touches the ground, the wings and wheels can be raised, throwing the entire weight of the planes on the skid which rapidly arrests forward motion The Waterman plane is powered with a Kinner C-5 190-hp engine, has a weight empty of 2,050 lb and a gross weight of 3,250 lb, with a wing area of 212 sq ft The wing section is a Gottingen 398

THE McDonnell "Doodle Bug" and the autogiros were intended to demonstrate the principles of quick take-off and climb at high angle of attack and vertical landing, respectively The "Doodle Bug," which has been described in AVIATION in connection with the Guggenheim Safe Aircraft Competition, is a low wing open monoplane embodying the use of leading edge slots and trailing edge flaps

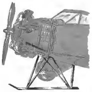
The autogiros demonstrated under the auspices of the Pitcairn-Cierva Company have been gradually improved and promise to be an exceedingly interesting development. Three machines were flown daily One of these had the special tail developed to facilitate starting the rotation of the vanes, and a more recent model had a mechanically started rotating system

The mechanical self starter on the latest autogiro consists essentially of a shaft and clutch, the shaft being driven by the engine and the clutch enabling the pilot to disengage the vane system from the shaft While this arrangement does not bring the vane system to its normal rotational speed, it is sufficient to facilitate starting Among the other features of the autogiro in its most recent form is the landing gear designed especially to absorb the shock of vertical landing This gear is of rugged construction and a travel of approximately 18 in is provided

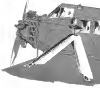
PASSING to the group of contesting planes the first in order of importance is probably the winner of the Thompson Trophy Race with a speed of 201 91 m p h The Laird "Solution" (1C DW 300) is a single bay biplane having an overall length of 19 ft, an overall height of 6 ft 6 in, upper wing span of 21 ft, and lower wing span of 18 ft The chord of the upper wing is 42 in, while that of the lower is 36 in, gap, 39 in and stagger, 21 in The upper wing is set in an incidence of 2 deg while that of the lower is $2\frac{1}{2}$ deg The upper wing is flat, while the lower dihedral is $1\frac{1}{2}$ deg There is no sweepback An M-6 airfoil section is used

The weight of the airplane empty is 1 380 lb, while the gross weight is 1 895 lb with a wing area of 112 sq ft, of which 9 2 sq ft constitutes ailerons Wing loading was 16 9 lb per sq ft and power loading, 4 21 lb per hp Fifty gallons of gasoline and seven gallons of

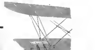
The Waldo Waterman variable wing monoplane with its designer and pilot Note the wide landing gear tread The power plant is a Kinner C 5 engine



Landing skid construction of the Waterman plane



Shock absorber strut and variable wing mechanism of the Waterman machine



The aileron balances used on the Italian Breda biplane which was flown daily as a part of the program

The Ensign powered Great Lakes biplane flown by Charlie Myers

oil were carried As indicated previously, the landing gear was of the straight axle type with Goodrich Air wheels

The power plant is a Pratt & Whitney Wasp Junior having supercharger impeller geared at a ratio of 10 to 1 and developing approximately 470 hp at 2,400 r p m The engine was equipped with a Hamilton Standard Propeller set at a pitch of 22 deg

The second place in the Thompson Trophy Race was taken by a Travelair Mystery S low-wing monoplane of the type recently described in AVIATION, while the third place was taken by the Howard Special, which was outstanding for its performance in several of the other contests The Howard Special was designed by Ben O.

Landing gear of the latest model Autogiro The shock absorber travel is approximately 14 in

Travel Air Mystery S monoplane piloted by Frank M. Hawks at the National Air Races Note cockpit enclosure

Howard of St Louis, assisted by Gordon Israel It is a low-winged monoplane of an especially clean design powered with the Wright Gipsy engine, and having a weight empty of 635 lb and a gross weight of 900 lb

The Howard Special had a wing span of 20 ft 1 in, an overall length of 17 ft 9 in and a wing area of 63 25 sq ft, excluding the streamlined surface used as a fairing for the axle This surface is built to the M-6 airfoil section and has an area of 3.75 sq ft The M 6 airfoil section also is used throughout the wing Structurally, the airplane is conventional

Two other airplanes were designed especially for the races and test flown successfully but met with unfortunate accident during the race One of these, the Rider B-1 flown by Lieut Macready, a light low-winged mono plane powered with the inverted Menasco Pirate engine was somewhat similar in general design to the Howard Special This plane had a 20-ft wing span, was 19 ft 6 in overall length, had 60 sq ft of wing area and weighed 875 lb gross A Clark Y-15 airfoil section was employed

The second of these planes was the Curtiss machine designed for Captain Arthur Page of the U S Marine Corps This airplane was a standard Hawk model of five years ago, which was considerably modified for the races The principal modification was the removal of the lower wing and installation of surface radiators in the upper wing A special two-member landing gear of exceptionally clean design was developed and the Conqueror engine was modified to operate at a compression ratio of 8.31 and supercharged in such a manner that it developed approximately 800 hp Both of these airplanes showed evidence of good performance in their test flight

Returning to the light plane class, there were two interesting contributions by the Heath Airplane Company of Chicago One of these, the Cannon Ball, is a low-wing monoplane having the latest redesigned Heath Henderson engine, and the other a super parasol, powered with a Bristol Cherub engine

CONSIDERING the airpanes constituting the visiting machines at the races, there were a number of interesting additions to the category of light single seaters Among these are included the Cessna EC-2, powered with the Aeronca engine and the American Eaglet, powered with either the Aeronca or the Szekely engine The Curtiss Conqueror powered Bellanca "Air Bus," the Northrup Alpha, the Fernic Crusair, the Burnelli twin-engined transport, a Richfield Stearman biplane, powered with a J 69 Wright engine equipped with a McLeod reversible propeller and the new Verville Trainer, were among the more interesting designs to be seen

Space prevents a detailed description of the foreign planes participating in the daily program These, however, were of the high performance type and did admirable work in the hands of their pilots

HOW CHICAGO TOOK THE AIR RACES

By Charles F. McReynolds

Pacific Coast Editor of AVIATION

THERE has been much questioning among leaders of the aviation industry during the past few years as to just what good the National Air Race meets do for the aviation industry This question is still open to much controversy There is one significant phase of the race meets, however, which can be definitely determined, and that is the good which they do the aviation industry in the immediate locality where they are staged.

In an effort to check the effect of the 1930 National Air Race meet upon the approximately three million people in the Chicago area, and in order to get the composite reactions of the four hundred odd thousands of people who paid to witness the events the writer conducted a personal survey of representative people Interviews were obtained with air race officials and Chicago civic leaders, with bankers and with factory workers, with vendors, ushers, and contesting pilots, with small boys, young men, old men, and old women (no young women were accosted as all of them, with few exceptions, were wearing trick costumes and parading up and down in front of the stands as lady pilots). Conversations were held with people who had never flown, were about to fly, or had just deplaned from their first flight We looked in store windows, listened to the radio and even read the newspapers in an effort to feel the aeronautical pulse of Chicago.

To say that approval of the race meet and confidence in the future of aviation was unanimous among those interviewed is putting it exceedingly mildly The attendance at the meet, in the neighborhood of four hundred thousand paid admissions, is the most eloquent expression of Chicago's acceptance of the aerial program, for the air races had some stiff competition in the matter of red-hot interest in the major league baseball games and horse racing events being staged during the air race period As one of the novelty vendors expressed it, we

were staging the air races in a baseball town Of course another factor which contributed to the difficulty of drawing record crowds to the air meet was that Chicago's citizens found it necessary to travel almost up to Wisconsin in order to reach the airport, the distance being 25 miles from the Loop

If the races accomplished nothing else for the Chicago district they succeeded in enthusing twenty leading Chicago men and an additional twenty groups of representative citizens from twenty towns around Chicago to put up five thousand dollars apiece in underwriting the affair. Certainly men are not going to put good hard cash on something, during this supposedly dull business year, unless they are heart and soul in sympathy with the project, and what is more important, unless they feel that they are at least going to get back their original investment There is a vast reservoir of wealth and of individual personal financial genius in the Chicago territory which has now definitely been tapped in support of aviation, and the further influence of which should be felt in the next couple of years as this support is extended to commercial phases of the industry

A further demonstration of the civic aeronautical good accomplished was evidenced in the constant and impassioned pleas to the people which were broadcast by radio and newspapers during the air race period, seeking public support for a great program of airport development in the vicinity of Chicago Certainly those people who traveled the many miles out to the scene of the airport cannot now fail to realize Chicago's dire need of better air terminal facilities closer to the Loop district.

There has been a great deal of speculation in the past about the effects of air races and aerial exhibitions on the public. To replace guesswork by first-hand information, *Aviation* commissioned Mr. McReynolds to investigate and report. The carefully considered conclusions here presented are his own. Some of them give indications radically different from those accepted in *Aviation's* editorial pages in the past, and even in this issue. The apparent conflict between Mr. McReynolds' observations and the opinions of the writer of the editorials are, however, explained in another place. The subject of what a race meet or exhibition should include, and of what the by-standers may think about it all, is one of very lively interest and great importance to the industry, and we especially invite opinions from our readers for our correspondence columns.

Enthusiastic Chicagoans cheer the parade of visiting flyers through the Loop district on the opening day of the National Air Races

STILL another factor which is bound to materially contribute to the increased acceptance of commercial aviation by Chicagoans was the exhaustingly intensive promotional effort which was staged to attract people to the race program In justice to Clifford W Henderson and his staff it must be said that this was certainly the best promoted air meet which has ever been held In fact, one cannot remember any event, even a war time Liberty Loan drive, which was so intensively fostered by every conceivable publicity device. The entire nation must have been drained of its model airplanes and aeronautical equipment in order to supply the exhibits seen in every Chicago hotel, department store, drug store, cigar stand, and anywhere else that posters, stickers, notices, announcements, or displays of model planes, propellers, engines, planes and equipment could be shown The radio, newspapers, street banners, and flags on all the taxicabs literally shouted aviation to everyone within the city's environs Certainly the people of the Chicago territory are now at least one hundred per cent more airplane conscious than they have ever been before, whether they attended the meet in person or not

Retuening to the scene of the air race program, and speaking more specifically of the reactions observed among those present at the events, we can offer the predominating trends of thought for what they may be worth Of even greater importance than the opinions obtained by direct questioning or purposeful eaves dropping, is the record of air passengers carried to and from, or at Curtiss-Wright-Reynolds Airport during the race meet Five hundred people flew to or from the race field via the Curtiss-Wright amphibian service which plied between the Chicago lake front and the airport Another fifteen hundred people patronized a boat, bus, landplane service which operated up the lake, across to Sky Harbor, and then on in to the airport by plane Still another six thousand people took the three dollar joy hops which were a regular evening feature of the race program That is a total of some eight thousand people or more who flew as a direct result of the air races, most of them for the first time, and they liked the experience and now crave more of it, particularly a longer flight Thus it is reasonable to suppose that within the next year a great number of the eight thousand initiated during the races will patronize some of the transport air lines now operating.

NOT only did these thousands of people express their enthusiasm for flying by actually taking a flight, but they showed that the general public is now differentiating clearly between stunt and race flying and commercial operation On the evening after Capt Arthur Page so tragically crashed in full view of the packed stands the people stood in line until after nine o'clock at night to fly in the Curtiss-Wright Fords, Robins, Travelairs, Command Aires, and the giant Condor. On one evening it was necessary to refund $900 for lack of flying equipment to handle the crowds When questioned on this matter they were all in accord in saying that air crashes did not adversely affect their confidence in the safety of commercial flying When questioned as to why they flew at all most of them either directly stated or indicated that the sight of so many planes in constant and violent maneuvers had made them become airplane conscious and desire to look at the world from up above When asked if the spectacular stunting exhibitions did not tend to frighten them away from flying and make them nervous they were unanimous in saying that the sight of planes being consistently stunted without mishap only served to give them added confidence in their

ability to take an ordinary straight-away flight without untoward results. Thus possibly for the first time in the history of the industry, we have direct proof that in a properly arranged program stunting can actually serve to encourage flying by those who have not previously flown Certainly future national air races and other large air race events should take advantage of this demonstration and plan the most intensive solicitation of aerial joy-hoppers in connection with the more daredevil phases of their programs

A less satisfactory phase of the joy-hopping at Chicago was that it is evident that the lay public does not yet differentiate between safe and unsafe commercial flying To them all commercial flying is now comparatively safe and they are willing to throw themselves upon the mercies of the operators This throws a distinct burden upon the industry to strive even more fanatically than ever before for consistently safer commercial flying We should not permit our desire to carry passengers to overrule our judgment of what constitutes safe conditions under which to fly Without doubt much of the commercial flying at Chicago was of a distinctly hazardous nature Planes were taking off simultaneously by the dozens at times, and in various directions, while other planes were landing with more valor than discretion Night operations were continued under conditions of fairly dense haze and when numbers of other airplanes were in the air at the same time and flying in all directions To many members of the industry on the grounds and in the stands this all proved the source of considerable apprehension, and we cannot be too thankful that there was no disastrous crash of a commercial airplane during the meet which would have proved many times more detrimental to the industry than all of the unfortunate race crashes together

For the air race program staged at Chicago it must be said that while it proved at times exceedingly boring for blasé members of the industry, the fan public literally "ate it up" Approval of the events seemed spontaneous on every hand and all seemed to feel that in spite of the high prices of admission to the grounds and stands, they had had their money's worth Nevertheless a close observer of the crowds became impressed with the fact that the audience was chiefly looking for tragic crashes or hair-breadth escapes rather than appreciating the real airmanship shown during much of the stunting, racing and formation flying

It was also of great interest to note how the enthusiasm of the audience increased even during the most thrilling events, when the announcer broadcast the latest scores of baseball games in progress It was evident that aviation and air races while interesting to the public, was by no means an all-embracing passion with them Perhaps the highest compliment paid the air races by any spectator was that passed during one of the most thrilling moments of the Thompson Trophy race when someone remarked that the event was almost as good as a horse race Nevertheless the final reaction of the crowds to all phases of the program proves definitely that they are interested and can be interested in closed course races a matter which has long been considered debatable Great appreciation was shown during the various free-for-alls, particularly the Thompson Trophy race, a couple of the women's races, and most all of the events in which B O Howard competed with his little white racer, which caught the fancy of the crowds from the start Much should be made of the closed course events in future and some featured free-for-all should be staged each day If racing teams can be organized by various wealthy men it will do much within the next few years to capitalize the possibilities of public interest

It is still evident, however, that public interest centers largely in exhibitions of stunting In this connection it was apparent that the crowds preferred breath taking but more or less meaningless exhibitions of close-in stunting such as that of Doret, who did little more than zoom down past the stands as though in an effort to see how close he could come to the ground without wiping of his landing gear or taking the wings from the planes of some of his foreign compatriots waiting their turn to go aloft They did appreciate Atcherley's masterful "crazy flying," in which he flew just off the ground, and much of the time on it with some or several parts of his plane touching, but the interest was chiefly for the humorous appearance of the flying and there was little realization of the difficulty of the feat or of the masterful airmanship which was being shown Likewise there was little interest shown in Al Williams' finished stunt performances which were staged at a safe altitude above the field

There was more interest in freak planes and in new types of planes than most officials and members of the aviation industry seemed to realize The crowds buzzed with query and comment whenever the Bellanca Air-bus or the Burnelli plane took the air, and showed the most intense interest in such new designs as the Northrop all-metal plane, and the Sikorsky amphibian, new to most of those present It is to be hoped that at future events a more direct effort will be made to show new types of commercial planes and the exhibition of such planes at air races should be encouraged in every way possible. One suggestion is to have one plane of every commercial type on the field taxied completely around the field in a ground airplane parade at some appropriate time during the program, after which they could take the air one by one for one flying circle of the race grounds, during which the announcer would give the audience a brief description of the type

Great interest was also shown in freak or radical airplanes such as the Waterman, McDonnell "Doodlebug" and the Autogiros There are a great many more freak planes in the country that were not shown and if some definite attempt were made to encourage participation of such planes in the National Air Races it would prove of great interest to the crowds, help to show them that literally almost anything can fly through the air in comparative safety, and it would prove a definite stimulus to the development of new types, assuring designers that their craft would at least have a showing and a chance to win popular acclaim

As stated at the beginning of this article, approval of the 1930 National Air Race program was unanimous and enthusiastic by the lay public and from the standpoint of a show for the entertainment of the people it was an unqualified success. There were many detailed criticisms of the way that many things were handled, the point being that while the public was satisfied with what they saw the resources of the aviation industry are such as to have made an even more interesting and instructive program possible That however, is another story and the race management is to be complimented upon having staged a meet which has reflected the greatest credit upon the aviation industry so far as its effect upon the people of Chicago is concerned

THE AIRPLANE WEIGHT COMPLEX

By A. A. Gassner

Chief Engineer, Fokker Aircraft Corp of America

A very sensitive spot in the consciousness of an aeronautical engineer relates to the weight breakdown of his airplane. There are obviously various reasons for this, some of which are sound. ¶In the present article Mr. Gassner gives freely of his vast store of experience, with the result that this is probably the first complete weight schedule that has been published for one of the giant airplanes and is undoubtedly the most detailed comparison of weights that has been submitted to the industry by any single manufacturer. We publish this with the hope that our readers will profit and others may follow the example set by the author.

One of the essentials of airplane design is the treatment of the weight problem To design a plane around a given engine with a minimum of dead weight and a maximum of useful load, at the same time fulfilling demands for strength of all structural and control parts is indeed a problem

The finished airplane should, of course, exceed in performance all machines of the same class previously built by the same concern, and must at least equal competitive designs

Commercial planes can be classified into three groups A—Mailplanes carrying only pilot and mail or express matters B—Training and sport planes of the open cockpit type C—Passenger transport planes of the cabin type.

In this paper we will consider only the latter type in detail, although the basic principles are of course alike for all kinds of airplanes

In the field of airplane design we find that most designers are very free in giving information as to wing areas, control surface areas, number and horsepower of engines and such facts With but a single exception, Mr C. Dornier, we have never seen statements given out by any designer on detailed weights of his planes Magazines and sales literature contain data on the weight empty of planes, but as a rule this data means little as the information as to what equipment and furnishings are included in this weight empty is lacking

In treating scientific or technical problems one is most always inclined to generalize However, one should, as far as possible, accumulate a large number of particular instances before attempting a generalization and then attempt to discover the reason that underlies that particular collection of similar instances

Table I

	Super-Universal Per Cent W E	Super-Universal Pounds	F.X.A Per Cent W E	F.X.A Pounds	F-32 Per Cent W E	F-32 Pounds	Average for Those 3 Types
Group A							
Weight outside designers influence	33 4	1 085	38 9	3 025	33 9	5 050	35 4
Group B							
Weight on which designer has limited influence	20 2	655	19 3	1 500	20 6	3,075	20 00
Group C							
Weight directly within designers influence	46 4	1 510	41 8	3 255	45 5	6 775	44 6
Weight empty lb		3 250 lb		7,780 lb.		14 900 lb	
Useful load	41 4	2 300 lb,	40 6	5 320 lb	38 6	9 350 lb	
Gross weight		5 550 lb		13 100 lb		24 250 lb	

We have available only the data on our own previously constructed machines, and unfortunately have to generalize on a rather limited number of particular cases It is hoped that the question brought up here will have a stimulating influence in persuading other airplane manufacturers to publish their experiences with this problem

The automobile industry is in a different position as to such trade secrets It has none Every concern buys and tries out models of the other manufacturers and I believe that the results prove profitable to everyone. Unfortunately the financial question prohibits the same methods

for the airplane industry and the airplane engineer is not able to check up on his competitors as is the automobile engineer

We will show that three items among others influence the weight of the plane

Dimensions and appointments of the fuselage or cabin necessary for the comfort of the passengers demands on fuel and oil capacity of the tanks and on cooling and operative facilities as made when the engine type, and the cruising range are given, and the necessary structural safety

We will endeavor to show that the weight of a plane is predetermined to a very large degree when we choose the engine type and the over all dimensions of the plane and that greatest care has to be taken in this respect. This fact explains why new machines of designers having long experience most always prove to be successful and that a plane specially designed around a given engine is most always better in general performance than one primarily designed for a different type engine and later equipped with a more powerful one

We would like also to point to the essential necessity of choosing the right kind of material and design details for all parts of the plane. We cannot draw a line today and say that all-metal construction is superior for the one type and composite design with steel tube fuselage is better for the other. Ease of production and adaptability to changes have a great influence on this selection. We can, however, say that one special type of design of tanks, engine mounts, floors, etc, is basically superior to another

The designer and manufacturer of the commercial transport plane has to solve a difficult problem. He must provide all this luxurious equipment the modern traveler demands and still keep the weight of the plane as low as possible to ensure good performance—a problem which does not exist to any such extent in other branches of manufacturing of transportation vehicles

The designer has less freedom in handling this weight problem than one might first suppose. Of course, all purchasers, be they private individuals, business corporations or operators of commercial airlines, consider the disposable load which can be carried by the plane as one of the most useful characteristics of the plane. As the gross weight has to be kept within rather narrow limits, it is necessary to reduce the weight empty of the plane if we want to increase the disposable load

There are a number of items on each plane which all have a prefixed weight which cannot be influenced by the designer. This group consists of engines, starters, propellers, wheels, tires, instruments, etc

The type and horsepower of the engine is in most cases given before the first sketches of the plane are made. Some times a different type of engine is substituted for the old one during the manufacturing of the plane, but in both cases the airplane designer has very little choice as the engine selection depends on a number of factors, as for instance price, horsepower, method of cooling, service facilities and reputation of the engine manufacturing company

By selection of engine we already have circumscribed

Table II—(Group A) Weights Outside of Designer's Direct Influence

	Super-Universal		F X A		F 32	
Engines with accessories	(1 Wasp-C)	720	(3 Wasp-C)	2 160	(4 Hornet B)	5 360
Propellers	(9 ft. 6 in. 2 blade)	90	(8 ft 6 in 2-blade)	309	(2 10 ft 2-blade)	542
					(2 9 ft 3-blade)	600
Starter installation	(Hand inertia)	26	(Hand inertia)	60	(Electric inertia)	160
Generator Assembly					(2 x 15 amp)	54
Starting booster	(Magneto)	10	(Magneto)	10	(Coils)	8
Ignition switches		1		4		5
Ammeter, light switches		2		5		4
Cabin dome lights		2		4		12
Battery and box	(55 amp-hr)	40	(70 amp-hr)	70	(2-70 amp hr)	140
Starter switches						6
Starter cables						10
Wheels with brakes	(32x6)	80	(44x10)	185	(54x12)	259
Tires and tubes	(36x8)	66	(44x10)	150	(58x14)	312
Tail wheel with tire						20
Flight instruments		15		15		14
Engine instruments		10		52		39
Starter chock and shaft extension		4		10		12
Hand fire extinguishers		7.5		15		15
First aid kit		4		4		8
Safety belts		6		14		32
Radio shielding of engines						50
Total group A		1 095 (lb)		3 025 (lb)		7 050 (lb)
Weight empty		3 250 (lb)		7 780 (lb)		14 900 (lb)
Group A per cent of weight empty		33 4 (per cent)		38 9 (per cent)		47 3 (per cent)

Table III—(Group B) Weights on which the Designer Has Limited Influence

	Super-Universal	F X A	F 32
Fuel tanks with supports	150[1]	140[2]	360[3]
Oil tanks with supports	10	35	65
Fuel piping	20	40	45
Oil piping	10	20	55
Nacelles and engine cowling	55	150	210
Exhaust system	45	140	250
Cabin heating system	15	20	40
Cabin and cockpit floors	40	150	350
Cabin windows and frames	50	130	150
Pilot's cockpit enclosure	40	60	122
Pilot's seats and supports	20	30	53
Cabin interior walls and doors	55	60	252
Fuselage outside doors	15	50	50
Elec light installation	10	20	28
Baggage racks cabin		20	22
Toilet equipment	20	20	40
Cabin wall paneling	20	35	126
Cabin sound insulation		70	127
Cabin upholstery	10	25	120
Brake control assembly	10	10	25
Instrument board and panel	5	15	10
Linoleum (floor)	10	30	50
Pass. chairs with cushions	60[4]	170[5]	580[6]
Engine controls	15	60	105
Total group B	655	1 500	3 075
Weight empty	3 250	7 780	14 900
Group B per cent of weight empty	20 2	19 5	20 6

[1] 2 65 gal. tanks [2] 2 140 gal tanks. [3] 4 175 gal. tanks [4] 6 chairs [5] 12 chairs [6] 8 chairs

the gross weight range of the airplane, have quite automatically selected the type and thereby the weight of starter, wheels and tires, propellers, engine instruments, ignition switches, etc. In most of the cases the purchaser of the plane gives specifications as to the electrical equipment to be used. This means that we will have to consider the weight of generator, batteries, electric light equipment, electric inertia starters with cables and switches, and all these weights are given and cannot be influenced by airplane designers. The Department of Commerce regulates that all commercial planes have to be equipped with safety belts for passengers and with first aid kits and hand fire extinguishers, weights of which equipment is also fixed

In a second group we have items on which the designer has a limited influence as far as weight is concerned, because he has but a limited choice of material and has to consider very definite requirements made by the sales department or by the purchaser of the plane. This second group consists of fuel and oil tanks, fuel and oil pipe lines, fuselage and nacelle cowlings, exhaust system, cabin and cockpit floors, cabin windows, pilots' and passenger seats, cabin interior walls and doors, upholstery, baggage racks, toilet equipment, cabin sound insulation, cabin floor carpet or linoleum, electric light installation and engine controls

The third group consists of weights of items on which the designer has direct influence. These are all structural parts as wings, fuselage, tail surfaces, landing gear structure, nacelle structure (outboard engine mount) and flying control group

In Tables I to 4 these weights and their percentage of weight empty are given for three entirely different types of planes. The Fokker Super-Universal, the Fokker F-10-A and the Fokker F-32. All these are well known in this country and their specifications are given in Table No 5. Although these machines are so entirely different from each other in engines, loads carried, size wing and power loading, the percentages of weight empty of groups *A*, *B*, and *C* are surprisingly close. The average percentage of weight empty is 35 4 percent for Group *A*, 20 percent for Group *B* and 44 6 percent for Group *C*

The fact that about 55 percent of the weight empty of any landplane of the commercial cabin type is either entirely outside of the plane designer's influence or can be influenced only to a very limited degree, is also indicated by a comparison of products built by different manufacturers around the same engines for the same general purpose but of different structural design

We want now to show how the requirements of operators and the choice of engines influence the weight of the empty plane and the gross weight. It is comparatively simple to calculate the required tank capacity for a specific cruising range.

Fuel tanks have a weight of .75 to 95 lb. per gal capacity if constructed of brass and a weight of .45 to 55 lb per gal. capacity if made of aluminum or aluminum alloy sheet

There are left to the designer but two possibilities of influencing the fuel tank weight. One is to increase the cruising speed and with a given distance between refueling to reduce the amount of fuel which has to be carried at take off. The second possibility is to use lighter material for the tank construction. Most planes built during the last few years, however, use aluminum tanks of either riveted or welded construction and further weight reduction in this type is not very probable on account of service and maintenance problems.

Table 4—(Group C) Weights Within Designer's Influence

	Super Universal	F X A	F-32
Wing Assembly	**830 lb**	**1,800 lb**	**3,536 lb**
Front Spar	160	480	950
Rear Spar	145	410	810
Ribs	81	160	355
Misc Woodwork	60	75	230
Covering 3-ply	270	425	810
Fittings	41	60	134
Fixed Equipment	45	60	61
Ailerons	28	72	105
Paint finish	50	58	72
Fuselage Group	**310 lb**	**600 lb**	**1,570 lb**
Fuselage Structure	265	520	1 300
Fairing Battens	18	80	135
Covering doped	32	60	136
Nacelle Structure		**290 lb**	**800 lb**
Tail Surface Assembly	**80 lb**	**170 lb**	**380 lb**
Stabilizer	32	62	135
Elevator	21	52	86
Fin	5	12	39
Rudder	14	21	55
Brace Struts	8	21	65
Landing Gear less Wheels	**210 lb**	**395 lb**	**980 lb**
Axle Assembly	64	155	290
Axle Brace Struts	22	26	76
Shock Absorber Strut Ass'y	72	135	136
Landing gear cowling	20	26	89
Brake Control	8	11	16
Tail wheel structure	24	52	75
Flying Controls Assembly	**36 lb**	**216 lb**	**170 lb**
Elevator control column	7	32	56
Rudder Pedals	6	25	22
Elevator and Rudder Control Cables	9	25	41
Aileron Control Cables	5	12	25
Stab Adj Mechanism	8	10	46

Table V—Design Data of Three Fokker Ships

	Super Universal	F-X-A	F-32
Length overall	36 ft, 6 in	50 ft	69 ft 10 in
Span	50 ft, 8 in	79 ft 3 in	99 ft
Engines	1 Wasp C 425 hp	3 Wasp C 1 275 hp	4 Hornet B 2,100 hp
Wing area total	387 sq ft	854 sq ft	1 322 sq ft
Weight empty	3 250 lb	7,780 lb	14 900 lb
Useful load	2 300 lb	5 320 lb	24 250 lb
Gross weight	5 550 lb	13 100 lb	9 550 lb
Wing loading	14 35 lb-sq ft	15 5 lb-sq ft	18 3 lb-sq ft
Power loading	13.1 10 -hp	10 5 lb hp	10 5 lb hp
Top speed	145 mph	154 mph	146 mph
Cruising speed	120 mph	126 mph	122 mph
Passenger and crew	8	14	32
Fuel capacity gal normal	120	560	500
Fuel consumed per cruising	20	60	110
Range at cruising speed	6 hr – 720 mi	6 hr – 755 mi	6½ hr 550 mi
Factor: $\frac{\text{No. passengers and crew} \times \text{mi at cruising}}{\text{fuel (gals)}}$	48 0	29 4	55 2

More promising is the way of increasing cruising speed The average range to be flown without refueling is about 500 mi If the plane has a cruising speed of 120 mi and is equipped with a single Wasp engine running at about 1600 r p m , the fuel consumption is 19 gal per hr , the duration of flight is 4 16 hr and the necessary fuel capacity therefore 79 gal If we build the tank of aluminum with a weight of 5 lb per gal capacity, the tank weighs 40 lb When we increase the cruising speed by 10 percent to 132 m p h , the duration becomes 3 79 hr , the fuel required is 72 gal and the tank weight 36 lb

In this particular case an increase of cruising speed by 10 percent means therefore a saving on tank weight of 10 percent

The fuel tank weight is, however, only between 2 and 4 percent of the weight empty as has been found for a great number of transport planes, and a saving of 10 percent of the tank weight is comparatively negligible by itself, as it would mean only a saving of 2 to 4 percent of the weight empty However, these possibilities of small individual savings repeat themselves many times during the designing of new planes and are well to be remembered as they may total up to 5 or 8 percent of the weight empty

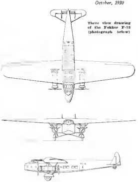
We have seen that an increase of cruising speed by 10 percent from 120 to 132 m p h. reduces the amount of fuel to be carried at take off for a range of 500 mi from 79 gal to 72 gal This means a weight reduction of $7 \times 6 = 42$ lb for the fuel and 4 lb for the fuel tanks The total saving of 46 lb can be either carried as pay load, or the wing can be reduced in area. For the single Wasp engined plane which we consider here, a wing loading of around 13 lb /sq ft would be appropriate

We could, therefore, reduce the wing area by about 3 sq ft , and if the wing weight is 1.8 lb /sq ft. we save another 5 4 lb

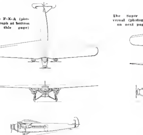
For this example we have thereby reduced the weight empty by the 4 lb as calculated for the fuel tank and 5 4 lb for the wing, i e a total of 9 4 lb The useful load has been reduced by 42 lb of fuel, the gross weight thereby by 51.4 lb

This single Wasp powered plane would have a gross weight of about 5,000 lb. and by all our careful consideration and the assumption of an increase of cruising speed of 120 m p h. by a full 10 percent, we were only able to save one percent of the gross weight of the plane

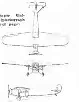
Oil tanks cannot be made smaller when we decrease the fuel tank capacity Because of the heating up of oil and because of the reserve capacity necessary, we



Three view drawing of the Fokker F-32 (photograph below)



The F-X-A (photograph at bottom of this page)



The Super Universal (photograph on next page)

cannot install tanks of a capacity of less than 3 gal for each one hundred brake horsepower of the engine

The only way to save weight in oil tank construction is the use of aluminum or aluminum alloy tanks instead of brass or terne plate tanks which were previously used

Fuel and oil lines again are more or less given with the choice of the engine, i e at least as far as their inside diameter is concerned We continue to use copper pipes for fuel lines as aluminum in the required small diameters is too easily damaged and more apt to crystallize Oil lines however are made of aluminum tube in most of the larger airplanes With the size of the pipelines we have also given the size and weight of all pipe fittings as well as the size and weight of fuel cocks, strainers, drains, etc.

The only possibility for the designer to save weight is, therefore, by decreasing the length of the pipelines. For the oil lines this can be done by placing the tank close to the engine The fuel tanks are now carried in the wing in most of the machines of the class under discussion, and the distance to the carburetor is determined by a number of other considerations as for instance weight distribution and balance and cannot be changed for the sake of saving a few feet of pipeline.

We are justified in saying that the weight of the fuel and oil pipelines is determined to 70 percent or more by the choice of the engine and only the remaining 30 per cent or less can be influenced by the designer

Cowling for aircooled engines is determined by cooperation between engine and plane manufacturer and we have found that in many cases the difficulty is to keep the engine warm enough contrary to the common conception Weight of cowling, which is of course always made of aluminum or aluminum alloy sheet, depends therefore to a very large extent on size and power of the engines The same is true for the exhaust system with the additional requirement of silencing means which are necessary for the comfort of pilot and passengers On some engines the exhaust system has to be made so that exhaust gases can be used for heating up the fuel mixture or so that air, preheated by exhaust, can be supplied to the carburetor Weights of such devices actually should be added to the engine weight, as it is most always impossible to operate the

engine without them Closely connected with the exhaust problem is the cabin heating question, as practically all planes are now heated by fresh air which passes over the hot exhaust pipes or mufflers

Cabin size and shape has of course great influence on design and size of cabin heater and efficient heating and ventilating is one of the many cases where consideration of passenger comfort requires additional or increased devices and therefore weight increase

Cabin floor space is determined by number of passengers carried For each passenger a floor space of at least 4½ sq ft area is required and the larger multi-engined planes provide 6 to 7 sq ft These figures include the floor space under chairs and benches but not floors in pilot's cockpit, entrance compartments, toilets galleys and baggage compartments This requirement of floor space and the necessary strength requirements largely determine the floor weights

Large cabin windows must be provided for passenger comfort and window panes and frames must be sufficiently strong to resist the air pressures The use of non-shatterable glass although advisable on account of its safety value, has the disadvantage of weight increase

Weight of window per passenger decreases with increasing size of the plane, as it becomes necessary to arrange three or four seats side by side and two passengers use one window

Cabin interiors with walls, doors, bulkheads, upholstery, soundproofing, baggage racks, chairs and cushions and a number of minor items, have to be designed for passenger comfort and become a rather intricate engineering problem with increase of size of the plane Many pounds can be saved or wasted on these items but the demands of operators and sales department are justly concentrated on satisfying the traveling public

THERE remains therefore only the group of structural parts on which the designer's influence on weights is not limited and this group makes approximately 45 percent of the weight empty If the designer is able to save as much as 10 percent of the weight of this group, he will be only saving 4½ percent of the weight empty or around 2½ percent of the gross weight And a lightening of the structural parts by 10 percent can only be accomplished by using the most efficient design and the best available materials

The necessity of weight saving as a means to make the transport plane a commercial success is however explained by the following line of thought Useful load of modern commercial planes amounts to approximately 40 per cent of the gross weight, which means of course that the weight of the empty but fully equipped plane is making up the remaining 60 per cent of gross weight Only about one half of the useful load is disposable or payload the rest is made up by the weight of crew, fuel and oil, special equipment, etc If we save now by structural efficiency 4½ per cent of the weight of the empty plane we can increase the payload by 13½ per cent and still have the same gross weight If an airplane has a gross weight of 12 000 lb, this means the original payload of 2 400 lb can be increased by 320 lb to 2,720 lb which means that two additional passengers or an equivalent weight in express matters or mail can be carried without additional expense Since a passenger mile in air traffic is sold now at around seven cents, and since a plane with a life of 3 000 hr flying time at a cruising speed of 100 m p h average travels a total of 300,000 mi the income during these 3,000 hr will be increased by fully $21,000 00—assumed, of course, that our public gets really air minded and uses the additional available seats, which have been made possible by the brain work of some aeronautical engineer

From all this it can be seen that only close cooperation and understanding between all parties concerned and closest control of weights of all parts of the airplane will have the desired effect of reducing the weight of the empty plane A logical procedure in starting a layout of a new type of plane would therefore be to first determine the weights as definitely given by choosing the engine and accessories and by determining weights of the group upon which the designer has limited influence During this stage, careful study is necessary to make sure that all the items of equipment and furnishing are really absolutely essential and that none of them could be spared in particular design Every effort has to be made to keep the size of the plane for a given engine, small and as commensurate to the comfort and safety of passengers and crew

A Fokker Super Universal

WEIGHT SAVING IN AIRPLANE STRUCTURES

Many estimates have heen made of the money value of weight saved in airplane structures and there is probably no more important problem confronting the aeronautical enigneer. The papers herein reviewed have been prepared by two men who have had long and profitable experience in simplifying aircraft construction with this ohject in view.

ASSUMING the necessary background in engineering knowledge there is probably no more important element in obtaining airplane structural efficiency than patience The value of structural efficiency has much to do with the dividend paying possibilities of a commercial airplane and a small saving in weight empty of a plane may produce a rather substantial increase in its earning capacity These were the impressions derived from the two papers on "Weight Saving by Structural Efficiency" presented during the eighteenth National Aeronautic Meeting of the Society of Automotive Engineers at the Palmer House, Chicago, during the recent National Air Races The authors were A A Gassner, chief engineer, Fokker Aircraft Corporation Division of General Motors Corporation, and Charles Ward Hall, president and chief engineer, of the Hall Aluminum Aircraft Corporation.

Mr Gassner's paper was more general of the two and treated briefly the entire problem of airplane design from the standpoint of structural efficiency, while that of Mr Hall was devoted mainly to the immediate problem of cutting down structural weight Both authors have had wide engineering experience, Mr Gassner with the use of wood and alloy steel and Mr Hall with aluminum alloy Mr Gassner pointed out that recent refinements in airplanes, tending to produce passenger comfort have resulted in many changes in structure and both authors show structural efficiency is a compromise with aerodynamic efficiency

In his paper, Mr Gassner showed that the weight empty of a plane may be divided into three groups One consists of approximately 35 per cent over which the designer has no influence whatsoever, the second consisting of fuel and oil tanks floors, bulkheads, chairs, windows, etc, representing 20 per cent and partially under the influence of the designer, and the third, including structural parts such as wings, fuselage, tail surfaces, landing gear and controls, comprising 45 per cent of the weight empty and over which the designer has complete influence He pointed out that a saving of 10 per cent of the structural weight could be accomplished only by most careful consideration of the design details yet would produce only a 4½ per cent reduction of the entire weight empty of the airplane, inasmuch as the weight empty makes up approximately 60 per cent of the gross weight and about one half of the remainder is payload, a saving of 4½ per cent of the weight empty, by structural efficiency makes it possible to increase the payload by 13½ per cent without altering the gross weight For example in the case of an airplane having a gross weight of 12,000 lb of which 2,400 lb is payload, some 320 lb can be added to the payload, making it possible to carry the equivalent of approximately two additional passengers Assuming average values for the life of an airplane and the cost per passenger-mile of air traffic, the income of this airplane will be increased $21,000

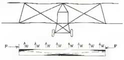


Fig 1—Diagram showing Hall method of curving gravity axes of wing spars Material distribution in chord members is shown below

A detailed study of these three weight groups in the case of several Fokker Planes is contained in an article by Mr Gassner on Page 217 of this issue

Mr Gassner stated the three characteristics of structural efficiency in airplane design as—

1 The choice of basic structural system best suited for aerodynamical space and wear requirements

2 The choice of the kind of material best suited for this basic structure

3 The use of selected material or materials in such a way that the least amount gives the required strength.

He showed the relationship of these three factors and the compromises that must necessarily be made in order to obtain the most efficient results in their use and indicated particularly that the present demand for comfort in transport planes is having a direct influence on the structural aspect of airplane design

Discussing the third of these factors, namely, the use of materials, he traced the development of a wing spar from the solid form to the I-beam and finally to the

built-up box type He then compared this with the usual forms of metal spar construction, stating that a European designer recently had made use of tapered sheet metal in the construction of spar flanges and webs so that the gage of the sheet stock decreased gradually towards the wing tips This method is somewhat suggestive of the method developed by Mr. Hall which will be described in some detail later in this paper

Included among his general suggestions for efficient structural design, Mr Gassner stated the wing beams, interplane struts, fuselage structure, and other units must be designed so that the ratio of ultimate strength over required design strength remains practically constant over the full length of the individual part This consideration is only one of those leading toward efficiency, however. Most of them are summed up in his statement that to design simple rigid structures having the material as far as possible from the neutral axis, avoid eccentricities as much as possible and reduce the bending, since a so-called pin-joined beam is always lighter than a beam in bending

In the preliminary design, a homogenous, simple, calculable system, following a theoretical law should be considered When this is done, each part should be studied in order to study the form which will allow the greatest inertia and rigidity for the same weight The ultimate aim of the aeronautical engineer is to obtain a small number of elements taking a big load, rather than a large number of small elements taking a small load Taking as an example the wing, he stated that those of the cantilever type should be thinned at the top and tapered in plan form The variation of the thickness and of the moments of inertia should follow continuous laws in order to avoid any discontinuity in the travel of the stresses, thus leading to what is often called "structural resonance"

Four factors seem to be influential on the weights of wings of similar design These factors are: first, aspect ratio; second, design load, which is gross weight of the plane minus wing weight multiplied by the load factor for high incidence condition, third, the area, and fourth, the maximum wing chord of tapered wings Another factor important from the standpoint of weight saving is the relief resulting from loads distributed over the wing span as nacelles with engines, oil tanks, etc, and fuel in wing tanks In connection with these four factors, Mr. Gassner presented a formula showing their relationship as follows:

$$\frac{\text{Aspect ratio} \times \text{Design load} \times \text{Area}}{\text{Max chord}} \times K = \text{Wing weight}$$

In this equation we have

Aspect ratio Square of span in feet over wing area in sq ft Total area of wing including part above fuselage, in sq ft Maximum chord at wing root, in inches. Wing weight in lb including ailerons, aileron cables and pulleys, all wing and nacelle attachment fittings, inspection doors, varnish or paint.

In applying this formula, it must be borne in mind that ratio of chord length to maximum rib height (max camber) is 5 for the root section of standard Fokker wing If this ratio is more or less for a wing whose weight is to be calculated, it will be necessary to obtain an equivalent chord for use in the above equation For example, the actual chord is 120 in, and the camber ratio is 6, indicating a maximum root rib height of 20 in, and the equivalent chord of the equation would be 20x5=100 in Because of the previously mentioned relief loads in tri-engined air-planes, this factor is slightly different for such machines, the value being K=1 1 for tri-engined planes or other types with engines supported in wing nacelles, and K=1 4 for single-engined machines For aircraft with greater loads distributed over the span, the factor will probably be K=1.0 The equation has been used on the wing of the Junkers L6 and gave a value of K=1 445 for this wing and 1 138 for Junkers G24. Table I gives these figures for eight typical wings and the factor K is found to be surprisingly constant for all of these which range in area from 386 to 1,360 sq ft, and as widely in span and design loads.

Mr. Gassner next described several types of cantilever wings ranging from multi-spar to mono-spar, and stated that the logical development of cantilever wing design would seem to be the coque or shell form because in this form the number of elements has been reduced to the minimum The rigid cover alone resists bending, torsion, axial load and local pressures The material can be distributed far from the neutral axis corresponding to the different planes of flexion In order to fulfill the above different duties, however, an adequate bracing system or rather a multicoque system must be devised

He further stated that stiffness, as well as strength,

Table I—Comparison of eleven airplanes with respect to factors influencing wing weights.

	F-VII	C-2	C-2A	XLB-2	F-X	F-X A	F-32	Junkers G24	F VIII	Super Univ	Junkers L6 (F-13)
Span	63' 3"	63'3"	73'	73'	71'5"	79'	99'	98 5'	75¼'	51½'	49'
Wing area total	618	618	740	748	710	850	1360	1100	890	593	469
Aspect ratio	6 47	6 47	7 15	7 13	7 07	7 35	7 22	8 8	6 41	6 8	5 13
Max chord	149	149	149	149	149	170	216	165	177	120	118½"
Camber root rib	5	5	5	5	5	5	4 7	5	5	5	5 55
Proportional chord							230	5			106½"
Gross Wgt. (design)	8800	9250	9586	12500	12500	12500	24250	14300	13700	5150	3930
Wing Weight	1050	1280	1750	1750	1760	1887	3526	3300	1950	800	596
Design Weight	7750	7970	7836	10750	10740	10713	20725	11000	11750	4350	3314
Load Factor H 1	4 5	5 5	5 5	4 5	4 5	4 5	4 5	4 5	4 5	6	5 5
Design Load	34 850	43 800	43 100	48 300	48 200	48 200	93 260	49 500	52 750	26,100	18,208
Factor A*	935	1175	1545	1665	1650	1770	3930	2900	1700	575	413
Factor K	1 122	1 09	1 132	1 05	1 07	1 065	1 13	1 138	1 15	1 39	1 445

$$^{*}\text{Factor A} = \frac{\text{Aspect Ratio} \times \text{Design load} \times \text{Area}}{\text{Max Chord}}$$

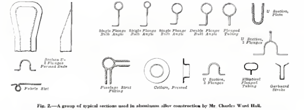


Fig. 2.—A group of typical sections used in aluminum alloy construction by Mr Charles Ward Hall.

must be considered in weight reduction Reduction of wing stiffness may cause diminution or complete loss of lateral control and it may reduce the critical flutter speed of the aircraft The former depends, of course, mainly on torsional stiffness, as the wing tends to twist and thereby changes its incidence, under aileron loads The latter effect is associated, in addition, with the flexural stiffness of the wing and with the stiffness moment about the aileron hinge due to the elasticities of the control system If these stiffnesses are all multipled by a given factor, the critical flutter speed is multiplied by the square root of that factor It is, therefore, apparent that cantilever wings cannot be designed to fulfill only strength requirrments

Elasticity and torsional stiffness have to be considered as at least of some importance In the conventional wing, the spars are the most important factors affecting wing stiffness, the flexural stiffness of the wing depends on their flexural stiffness, and the torsional stiffness of the wing on their flexural stiffness and on the distance between thrm The effect of increase or decrease of spar flexural strength on wing flexural stiffness is, therefore, a matter of primary importance The flexural stiffness is also of greatest importance in the design of tail surfaces and fuselage rear ends, which often have to stand rough handling by the ground crew. Mr Gassner pointed out that in aeronautical design, statically indeterminate systems are more often the rule than the exception and deplored the fact that there was too much assumption and too little mathematics involved in structural work, which contributes to wasted weight and its unfortunate results He recommended the use of statically determined systems wherever possible and, when impossible, an analysis of the systems by the elasticity methods, accompanied by tests to determine the form factors of the specimens

Mr Gassner next spoke of the close relationship of the selection of basic structure and the selection of best suited material and their effects on the ultimate weight of the structure He discussed the various materials including alloy steels, magnesium alloys, aluminum and its alloys and concluded by stating that nature had developed wood, a material which man could not duplicate by chemical processes and whose weight-strength ratio and endurance, especially against vibration effects, makes it most interesting when compared to steel or light metal alloy He then mentioned the struggle between the advocates of metal and composite design In concluding, the author stated that if we want to save weight, we must know the weight of our structure in close estimation before we begin the detailing We should also know the weight of competitive ships in a somewhat detailed breakdown Although this has not been available, up to the present time, the first presentation of such data is made in the article by Mr Gassner, "The Airplane Weight Complex," on page 217 of this issue

Mr Hall, in his paper, eliminated at the outset a division of structural work which embraces the determination of the loading conditions, and devoted himself to a discussion of the design of structures to sustain certain predetermined loads, with a minimum expenditure of weight After discussing briefly the necessity of minimum structure weight from the viewpoint of payload, he subdivided the parts of an airplane structure into four general groups of members Those subject to tension, bending, direct compression, and to combined bending and compression, giving examples of each of these classes of members

Mr Hall emphasized the effect of efficient structure on the total price, rather than the earning capacity of the airplane He stressed the necessity of arrangement of the parts of the plane with relation to each other and to the loads they must carry and also the proper selection of the best available cross sectional form

According to Mr Hall, the essential relation of the parts and the structure to each other and to the load is the one whereby the load is carried but once and then directly to its final supports, and these supports should lie approximately in a plane parallel to the load vector. Also, in cases where the load unavoidably causes a bending moment, the support attachments must be arranged to produce a moment of contrary sign and if possible of the same magnitude Over-correction of a force or moment should in general be avoided, as it usually results in an unstable relation of the parts of the framework Care should also be taken to avoid loads due to secondary bending and to utilize the advantages and full continuity over any supports, both may be accomplished in all cases through simple arrangement. As a general principle, complete concentricity of joints should be attained There are cases, however, in which a certain amount of eccentricity results in greater strength from a given member. Construction cost may be kept at a minimum by the

selection of sections to which it is relatively easy to fasten the adjoining parts and by reducing the number of fastenings to a minimum. Wherever the design permits of power tools instead of hand tools for assembly, the advantages in cost are obvious. Types of section favorable to power assembly methods are by no means limited to angles, open channels, I beams, etc, but on the contrary include the much more structurally efficient enclosed hollow sections when these are designed especially to afford cheap connection. The remainder of Mr Hall's paper was explanation of a number of lantern slides reproduced from photographs taken at his Buffalo plant and illustrating the application of his structural principles. The first of these was a single seater fighter plane, showing the lift wires attached to a common point on the fuselage. This point was so selected that the high incidence and the low incidence lift-drag force vectors pass through it. Such an arrangement, with the wing profiles in common use, almost completely eliminates the need of internal drag bracing for the usual conditions of flight.

ONE of the most interesting applications of Mr. Hall's principles is his method of saving weight by curving the gravity axis of a member in anticipation of the load to which it is to be subjected.

Figure 1 shows diagrammatically a single bay biplane having spars thus cambered. It is obvious that these spars are curved in such a way that the air loads tend to straighten them while in those positions of flight when they are simultaneously subjected to compression. If correctly detailed, the spars will be perfectly straight when they are under their maximum intended loading, hence the secondary bending moment which forms the basis of all column formulas and is expressed by the product of the end load by eccentricity, is eliminated. It is interesting to note that failure occurs only at very high stress and then by a sidewise bending of the spar in the plane of the drag trussing.

If instead of curving the entire spar in a sense contrary to the deflection produced by the loading, material is omitted from those parts of the spar chords where the bending stress and the axial stress are of opposite signs, the gravity axis of the spar becomes cambered in the desired direction, thus increasing the strength of a member by decreasing its weight. The distribution of material in the spar chords is illustrated in the lower portion of the diagram Fig. 1.

One of the lantern slides illustrated the characteristics multi-tubular spar construction developed by way of application of Mr. Hall's principles. In order to produce the desired result the size and number of web tubes are varied. In the cut-away portions of the interrupted tubes the load is transferred gradually by each of four rivets. A "Y" form of the drag strut fitting plate was also shown which avoids any change in panel length and the very large secondary stresses resulting from some such arrangements.

This general idea is also found in other portions of the structures of Hall airplanes. Rib web members are tapered along their length and the cutting away of material near their ends, curves the gravity axis in the desired way. In the usual proportion, a web member being 8 or 10 per cent larger at their mid points than near the ends, enables at least 40 per cent more load to be carried by a given sectional area.

In Fig. 2 are shown a number of sections developed by Mr Hall for aircraft structures, and widely used in aluminum alloy construction throughout the country. Practically all of them are of the closed hollow type and may be considered as tubes, combined with grips for attachment on other parts. Most of these sections, together with the general principles of Hall construction, have been described in some detail in the November 30, 1929, issue of AVIATION. The advantages of the use of this method of construction are ease of assembly and repair. A minimum of rivets is used in building up any structure and most are made to serve more than one purpose.

Another interesting principle of this type of construction is that of full continuity of all parts at any intersection and is a most important factor in building strong rugged structures of light weight. In this connection, Mr Hall showed a photograph of a half section of float or pontoon construction, using the standardized parts. The frames are fully continuous and the stringers run through without interruption for their entire length. The method of affording continuity when passing through a watertight bulkhead is similar for either stringer or frames and consists of the insertion of a plugged length of seamless tubing extending a short distance into the hollow part of each section to be joined where it is secured by through rivets. This tube is provided with pressed collars on each side that retain the sealing material.

The necessity of careful investigation of each member and its relation to other members is characteristic of the Hall system of structural analysis.

Mr Hall also showed photographs of some of the special machines developed for use at his plant. Among these was a gang riveter which performs three operations at once. At one point the plates are cupped into each other, forming a dimple. In the dimple just formed, a hole is punched and a rivet is inserted and headed flush with the outside of the plate. Each time the jaws close, these three operations take place, resulting in one completed rivet and preparation for the next two rivets. It is estimated that this saving of the plating assembly labor by using this machine is approximately 70 per cent.

In the discussion that followed information was requested on the relative unit weight of taper and straight wing structures. Mr Hall replied that the difference was small and probably did not exceed 10 per cent. He was also asked the lightest unit weight for aluminum alloy wing struts to which he replied that some structures were as light as .92 lb per sq ft and that the highest value was 1.08 lb per sq ft.

Wesley L. Smith requested information about the Hall type of construction applied to full or semi-cantilever wings, whereupon Mr. Hall replied that the full cantilever wing could be regarded simply as the tip of an ordinary braced wing. At this point the chairman, Mr. A. A. Mooney, asked the audience for information regarding the unit weight of cantilever wings. Mr Edward Wallace, of Wright Field, replied that those coming under his observation ranged between 1.1 and 1.75 lb per sq ft, and Mr Garland P. Peed, Jr, formerly of the Alexander Aircraft Corporation, stated that the weight of the wing of the Alexander Bullet was approximately 2.5 lb per sq ft including tanks and other fittings.

When asked about the possibilities of Beryllium in aircraft construction, Mr. Hall responded that it was extremely expensive at the present time but was interesting from a laboratory point of view. He was then asked about the availability of the S. R. T. Aluminum Alloy from the Aluminum Company of America, to which he responded that he believed that this material was being delivered at the present time to the Goodyear Zeppelin Corporation.

THE SPINNING SYMPOSIUM OF THE S.A.E.

More than eight hundred factors, some of which are not important, determine the spinning characteristics of an airplane. Six expert opinions, all based on actual experience, show a definite need for scientific investigation of these factors after the nomenclature associated with the problem has been clarified and standardized.

CO-ORDINATION and classification of research results, and further investigation under actual full scale conditions are probably the most important factors necessary to the ultimate solution of the spinning problem in airplanes as indicated by the opinions expressed at the symposium on aircraft spinning which marked the Wednesday evening session of the Society of Automotive Engineers during the Chicago National Air Races.

One insistent need, as brought out by this symposium, is that of accurate nomenclature and clarification of terms related to the problem. Two of the speakers objected definitely to the term "flat spin," while others did likewise by inference. However an absolute standard of terminology must be adopted before going further with the solution of the problem.

Six men, all of whom have had intimate contact with the problem, presented views that were in many respects divergent and it is extremely unfortunate that the period of time allotted for this session could not have been extended to permit complete reading of all of the papers as well as discussions. As it was many of the readers were forced to abridge their presentations and the lateness of the hour, following reading of the final paper discouraged discussion. If, however, this symposium has impressed the importance of the above mentioned factors on the minds of those interested in the problem, it has most certainly served its purpose.

The first five papers were devoted mainly to an exposition of the experiences of their authors in actual spinning problems from the standpoint of the test pilots and aeronautical engineer while the final paper by Mr Fred E. Weick, of the National Advisory Committee for Aeronautics was somewhat more general and embraced an outline of the entire problem as it is now being studied by means of full scale flight measurements at the laboratories of the N.A.C.A. at Langley Field Virginia. It is somewhat easier to appreciate the scope of the problem when one realizes that Mr. Weick and his associates have shown that there are more than eight hundred factors affecting the spin. Many of these are negligible and a large group are known to be highly important, but by far the majority have not yet been investigated and therefore the degree of importance of this group is unknown. It is the object of the N.A.C.A. to make a systematic investigation of all of these factors by accurate measurement in full scale flight tests.

The first speaker of the evening was Lieut. Carl Harper, U.S.N. retired. Lieut. Harper spoke briefly of the history of the spin and its evolution through the stages of an uncontrolled, normally controlled, and unnormal maneuver, the latter constituting his definition for the spin. He pointed out that at first biplanes were considered to be the principal offenders but that later spinning characteristics were discovered in the monoplane.

After describing the operations necessary to put a plane into a normal spin, and stating that the flat spin usually starts during the third or fourth turn of a normal spin, Lieutenant Harper cited the experience of various famous pilots in normal and flat spinning. He advocated as a remedy the extensive use of wind tunnels by designers and deplored the fact that there were too few competent test pilots. He also suggested that pressure distribution tests be conducted on wings at extremely high angles of attack and concluded his paper by the statement that the wing slot is a better remedy for the spin than is generally believed.

BASING his presentation on his experience as engineer and test pilot for the Keystone-Loening Aircraft Corporation, Division Curtiss-Wright Corporation, Paul E. Hovgard was the second speaker in the evening session. Mr Hovgard began his paper with the statement that the force behind the rotation of the airplane is primarily its weight, the greater the weight, the more rapid the rate of rotation. He stated that in tests it was found possible to omit enough of the useful load of the airplane to be able to perform prolonged spins without going into a flat spin. Ballast was then added at the center of gravity to increase the weight without changing the moment of inertia about any axis appreciably. As the weight at this point was increased, the rate of rotation was increased until it reached its critical point resulting in a flat spin.

In the test described by Mr Hovgard, the ballast was then moved from central location to various points in the tail and fuselage, engine mount and center section, wing tips and in the bottom of the pontoon. Moving the ballast to the wing tips or to the engine and tail made

the spin more difficult to start With ballast at the wing tips, the number of turns for a normal spin before becoming flat was increased while with the ballast in the nose and tail, the number of normal turns very markedly decreased The recovery from the flat spin, in either case, was practically the same With the weights in the center sertion and bottom of the pontoon there was no difference in the entry to the spin and the transition from a normal to a flat spin was almost unnoticeable Recovery from a long spin was made in one and one-half turns, whereas recovery from spins, in the previous condition, required five turns Full down-elevator and opposite rudder and aileron were used

All of the above tests were made with the same center of gravity location and tests were later made on the center of gravity location without changing the moments

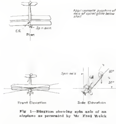


Fig 1—Diagram showing spin axis of an airplane as presented by Mr Fred Weick

of inertia or static weight but by using various degrees of sweepback The center of gravity was moved in four stages from 40 to 26 per cent of the mean chord In the most forward position, it was impossible to enter a spin without first increasing the up-elevator throw As the center of gravity was moved forward, the spins were more difficult to start but recovery from a long spin was unchanged In one case, by reducing the up-elevator throw, it was possible to make a prolonged spin without going flat The center of gravity was then moved two per cent of the mean chord. It was then necessary to increase the up-elevator throw to start a spin but it was impossible so to adjust the up-elevator that the airplane could be spun without going flat

Further experiments were conducted to determine the effect of decalage and washout and the stability in roll Incorporation of these features made the spin slightly easier to start but it could not be carried nearly so far Until enough decalage and washout was incorporated, however, to eliminate the flat spin entirely, there was no difference in ability to recover from the flat spin When carried far enough, the rate of rotation increased as the control column was pulled to the rear As the rate of rotation increased, the force required to hold the stick in the rear position also increased and when the stick was released, the plane snapped out of the spin in about one-half turn Mr Hovgard stated incidentally that the stability of the airplane in normal flight, after decalage and washout had been introduced, was uncanny.

In the course of his experiments, Mr Hovgard discovered that the most dependable change to remedy spinning characteristics was an increase in the area of the horizontal tail The area of this surface was increased by degrees to about 80 per cent more than its original value After an increase of approximately 50 per cent, further increment was not effective. Increase of 50 per cent of this value reduced the number of turns required for recovery from a flat spin from five to three and one-quarter A 100 per cent increase in fin area had very little effect on the recovery from flat spins, the reduction in number of turns being five and one quarter to four and three-quarters Raising the horizontal surface 32 in above its normal position had no effect whatsoever on the spinning characteristics A positive dihedral of 10 deg in the horizontal tail reduced the number of turns required for recovery from three and one-quarter to one and one-quarter.

Mr Hovgard next discussed the position of the axis of rotation of the airplane or wing cellute He stated that contrary to the belief that this axis passed through the center of gravity or intersected the longitudinal axis in the same plane as the vertical axis, test pilots report a side force or a yaw in the spin which indicates either that the axis is to one side of the longitudinal axis or the axis of rotation is not in the same plane as the vertical axis In a normal spin, the axis of rotation intersects or nearly intersects the longitudinal axis, but it appears that when the rate of notation has reached a certain point, it is not stable in this position

Tracing the history of his experience with spins, Temple N Joyce was the third speaker on the program Mr Joyce told of his first experiences with spinning at Issoudum, France, in the Spring of 1918, when he learned from one of the French instructors how to execute a so-called flat spin in the eighteen meter Nieuport He criticised the term "flat spin" because of the fact that the same aerodynamic conditions might exist with the fuselage very flat or almost vertical, the two conditions being exactly alike in the fact that recovery is difficult and in most cases accompanied by a reversal of strict forces He then went on to describe certain tests conducted by him in 1928 in an effort to learn about the characteristics of an airplane in which he was interested These tests were begun under the lightest loading conditions and it was found that, in a fast barrel roll, when an attempt was made to execute only a single roll, it was impossible to do so By the time the plane had reached the stalling point it had rolled almost beyond the upside down position, by which time it was too late with the existing effectiveness of the control surfaces, to retard the rotation and bring the plane out with the completion of only one full roll Invariably, if the stick and rudder were held until the plane actually stalled then the controls reversed, the plane would pass through a single full roll with the nose dropping, yawing and rolling, and in many instances would continue on over in an almost inverted position After pulling the stick and giving full rudder if they were taken off before the wing actually stalled a single roll could be completed but it would be nothing more than a sloppy combination aileron and rudder maneuver.

In an effort to have the plane execute fast barrel rolls satisfactorily, a new set of control surfaces was made

with approximately fifty per cent increase in elevator area and about twenty per cent increase in rudder area It was found that the rolling condition was but partly improved and in all instances, the plane, upon executing one complete roll, would come out rolling, yawing and pitching regardless of the opposite control position Elevators, however, were quite effective and the spin tests were attempted

After a number of experiments, the reversal of stick forces was noted and in further flight, this condition was allowed to continue for about 1,500 ft, in which case recovery was quite prolonged and there was no tendency on the part of the fuselage to flatten out.

Addition of 2 2 sq ft of area to the elevators was all that was required to throw the airplane from a condition where there was no delayed recovery or reversal of stick forces when spinning to the right, and only developing to the left after about twenty-five hundred feet of prolonged spinning, to reversal of stick forces and delayed recovery to the right at 600 ft In subsequent spins, all of which were done with the same loading conditions (c g about 24 per cent), the airplane was made to spin in a perfectly flat attitude, stick forces very high and quite delayed recovery In this attitude, the plane rotated rather rapidly with indications of a relatively slow velocity and wings banked to the side of rotation It developed a reaction on the pilot to the rearward and to the inside of a spin This reaction was so strong that it required special effort to move the stick to its most forward position Further experiments indicated that an airplane spinning with uneven motion is bordering close to the delayed recovery condition and a slight change in the position of the center of gravity might make it a dangerous plane

On the basis of his experience, Mr Joyce concluded that an apparently normal spinning airplane might, under conditions be made to spin abnormally and a delayed recovery condition be brought about He further concluded that the manner in which a spin is entered has much to do with its later characteristics In closing Mr Joyce reiterated that the term "flat spin" is misleading He added that there should be some differentiation between stable auto-rotation as applied to a wing cellule and auto rotation as applied to a complete airplane, taking into effect the action of the controls and also that rotation of an airplane which may be absolutely independent of any control movement once the spin has developed He stated that in this connection, the nomenclature should be revised to differentiate between stable and unstable spinning airplanes He advanced the opinion that the easiest way to solve these problems related to the spin is to have them correctly defined in the beginning and that further clarification as to terminology is needed as a first step in the solution of the problems

Following Mr Joyce, Garland Powell Peed, Jr , formerly associated with the redesign of the Alexander Bullet, told of his experiences in an effort to remedy the spinning characteristics of the Bullet Mr Peed did not read his paper but spoke extemporaneously. He stated that in his analysis of the Bullet problem, all previous knowledge of spins was discarded and the conclusions drawn from his experience were, that for low wing monoplane the load should be high and to the rear in order to obtain non-spinning characteristics After this was done, the Bullet behaved in a somewhat peculiar way Instead of spinning it would describe a series of falling leaves and under certain loading conditions would fall almost vertically at a velocity sufficiently low to permit of safe landing. In his paper, Mr Peed calls attention to the fact that the term "flat spin" was misleading and suggested the use of "controlled" and "uncontrolled" for "normal" and "flat" spinning He pointed out that all planes will revert to normal flight more easily from the inverted flat spin, and stated that this was not due to any characteristics of the plane but to the fact that it is easier for the pilot to apply full opposite elevator in this position He stressed the fact that in a straight, flat spin, there is almost no airplane that will not come out if full control is applied and held, but that there are few pilots who are able to do this because of the psychological and physiological conditions accompanying the experience Mr Peed defined a spin as a stalled spiral and added that the more efficient the airplane, the flatter the spiral until the flat or uncontrolled spin is reached He criticised the use of stops on the controls in an effort to prevent spinning Stressing the initial turn as an important factor, he stated that if the causes for the initial turn or start of the spin are known, it is a very simple matter to show why the plane continues to spin He drew a distinction between a spinning accident and stalling accident and called attention to the fact that a true spin takes from 200 to 800 ft to develop

Mr. Peed presented and explained mathematical equations of the spin and discussed their application to biplane and monoplane, particularly those of the cantilever low wing type He also stated that center of gravity location had little to do with the spinning characteristics In this connection, he called attention to the fact that certain biplanes will spin flat with forward center of gravity, but are perfectly normal when rigged properly with the center of gravity further aft

He also touched upon the fact that the lift of the tail surfaces must be taken into account. At high angles of attack, above 30 deg , the horizontal surfaces will carry as much load per square foot as the wings, the only major variation being due to aspect ratio This lift is not affected as much as might be expected by forcing the elevators down, especially at angles above 70 deg , though the corrective effort is generally sufficient if they are forced to the extreme limit of their travel. A rearward progression of moments in a spin merely acts as a shifting of the load rearward, this loads up the tail surfaces until they have attained an angle of attack and velocity enough to support the load The spin is due to the inability of the inner wing to carry its share of the load In closing he stated that research should be directed toward preventing the stall, rather than postponing it to a slightly higher angle of attack

The fifth speaker, Capt Harry A Sutton, did not read his paper but discussed briefly the subject matter and showed motion pictures of a number of spinning tests made under the auspices of the U S Army Air Corps at Wright Field In his paper, Mr. Sutton outlined the experiments in full flight, conducted by himself during a long period of time after the wind tunnel had been abandoned as a medium for study of the spin The first systematic program of tests was started to determine on two airplanes differing greatly in wing cellule arrangement, the effects and spinning characteristics resulting from varying the center of gravity location, mass distribution, control position and engine power. Additional tests were made to determine the effect of lateral mass distribution which proved to be an important factor

while the next tests were made to determine the effect of changing the mass distribution along the fuselage axis for several balance locations It was found impractical to increase the mass distribution along the vertical axis to any appreciable extent and no tests of this nature were made although it was realized that such were highly desirable

The tests demonstrated that a rearward balance location made recovery from spins more difficult increase in lateral mass distribution had a similar effect longitudinal mass distribution had no appreciable effect, power application had small effect and that the control positions used in attempting recovery had a marked effect In cases of easy recovery control positions were not important but whenever recovery became difficult it was advisable to apply immediately maximum reversed controls and to hold them fixed in the maximum positions Captain Sutton stated that the only safe method of stopping a spin is to use all of the down elevator and all of the rudder motion against the spin, maintaining the controls in these positions Ailerons are usually least effective in stopping a spin, while elevator and rudder are usually the most effective in the order named The use of power was of slight benefit in some cases, however, in many spins the engine ceased to function

A similar series of tests were made on an airplane having a wing cellule incorporating both sweepback and stagger The center of gravity was moved to the rear until an unsatisfactory spinning condition was reached, at a balance location about 38.5 per cent of the mean aerodynamic chord The test gave the same results so far as ease of recovery from spin was concerned and about the same balance location as in the first test on an airplane having a very different wing cellule arrangement They also demonstrated that spinning attitude does not in itself indicate the ease of recovery since the first airplane spun flat when recovery was difficult while the second airplane spun steeply with as great difficulty in recovery The second airplane spun with its X axis more nearly horizontal with the balance well forward and in this condition recovery was very easy

The effect of increasing the lateral mass distribution along the lateral axis was investigated for two balance locations Results were considerably different from those obtained in the first airplane

Upon completion of flight tests, the moments of inertia of the two airplanes about the "X", "Y", and "Z" axes were determined experimentally

Mr Sutton stated the problem at present as being one of securing reliable and sufficient data to insure that an airplane be designed to provide easy recovery from any spins that it may be capable of performing. Further refinements must await the results of extensive research Tests were also made on several airplanes equipped with automatic slots In each case, it was found that the airplanes could be spun and that after they started spinning the slots had no appreciable effect. It was somewhat more difficult to spin these airplanes since the slots provided an increase in lateral stability at large angles of attack

The test showed that it is quite possible to load an airplane so that it is impossible to stop a tail spin which has definitely started Recovery becomes increasingly difficult as weight is added behind the wings and the center of gravity of an airplane is moved rearward The center of gravity may be moved so far aft that it is impossible to get the plane out of a spin after it starts Since the loading condition effects recovery from spins, it is true that there are many different methods of using the controls which may stop spins under certain conditions of loading

In closing Mr Sutton drew attention to the fact that many manufacturers have had considerable flight test experience with spinning and advocated that this information should be made available in proper form for general use He mentioned the recently started series of flight tests by the N A C A to determine the effect of various design factors on spinning and stated that the factors which should be investigated include wing cellule arrangement balance location mass distribution vertical and horizontal tail surface design, high and low wing monoplane arrangement, and others of presumably less importance

As a fitting close for the symposium on spinning a paper entitled "The Present Status of Research on Airplane Spinning" was read by Fred E. Weick of the National Advisory Committee for Aeronautics In his paper Mr Weick touched upon the scope of the research problem involved and the ground covered to date in the solution of the many factors involved in the problem Only the steady spin and the recovery from it was considered

Mr Weick began by calling attention to an important advance in spinning research, i e, the development of a method of measuring accurately the flight path of an airplane and its attitude at each point This method which is the result of instrument development in the N A C A laboratory consists essentially of measuring the rates of rotation about the three principal axes of the plane by means of three gyroscopic turnmeters, the accelerations about the same three axes with a three-component accelerometer placed at the center of gravity, and the vertical velocity Measurements are also made of positions of the controls, and these, as well as the rotations and accelerations, are recorded photographically In actual test, the spin is maintained for about 1,000 ft before the instruments are started, and then the instruments are run for exactly 1,000 ft, the rate of descent being obtained from timing lines on the records Then from the records, calculations are made of the flight path, the radius, the attitude of the airplane and the inertia couples For this the moments of inertia of the airplane about its principal axes must be known, and this has also been a hindrance to previous investigators These values are obtained by swinging the airplane as a pendulum mounted on knife edges and the process has finally been developed to the point where the results are accurate to within one per cent

Outlining the results accomplished thus far Mr Weick stated that it has been found that the path of center of gravity of the airplane moved is a very steep helix, the radius being much smaller than previously believed The average for this value seems to be about six feet and the maximum to date slightly over nine feet In every case measured so far, the spin axis or center of rotation, has been close to the nose of the airplane as shown in Fig 1 Obviously the plane spinning about such an axis has an entirely different motion from that in an ordinary spiral glide of the same vertical velocity where the rotation is about an axis far to one side of the airplane The attitude of the longitudinal axis of the airplane varies in different spins from the steepest at about 60 deg to the horizontal to the flattest at about 30 deg The smaller angle was obtained in the case of the XB-1 It is likely that

Table 1: Factors Affecting Steady Spin

I Aerodynamic Forces and Couples

A Airfoils
- (a) Sections 1-36
- (b) Slots 1-36
- (c) Flaps 1-36

B Variation along span
- (a) Plan form 1-36
- (b) Sweepback 1-36
- (c) Dihedral 1-36
- (d) Washout 1-36
- (e) Change of section 1-36

C Biplane Multiplane Combinations
- (a) Gap 1-36
- (b) Stagger 1-36
- (c) Decalage 1-36
- (d) Different sized plane combinations 1-36
- (e) Pilot planes. 1-36

D Tail Surfaces.
- (a) Relative size. 1-36.
- (b) Distance from c g. 1-36
- (c) Shape and arrangement 1-36
- (d) Airfoil sections 1-36
- (e) Fuselage shape and interference. 1-36

E Control Surfaces
- (a) Ailerons deflected various amounts.
  - 1—36
  - 37—Rolling moment due to deflected ailerons.
  - 38—Yawing moment due to deflected ailerons
  - 39—Pitching moment due to deflected ailerons
- (b) Rudder deflected various amounts
  - 1—36
  - 37—Rolling moment due to deflected rudder
  - 38—Yawing moment due to deflected rudder
  - 39—Pitching moment due to deflected rudder
- (c) Elevator deflected various amounts
  - 37—Rolling moment due to deflected elevator
  - 1 36
  - 38—Yawing moment due to deflected elevator
  - 39—Pitching moment due to deflected elevator

II Inertia Forces and Couples

A Ellipsoid of Inertia
- (a) Rolling inertia couple
- (b) Yawing inertia couple
- (c) Pitching inertia couple

B Precessional Moment Due to Propeller
- (a) Rolling moment.
- (b) Yawing moment.
- (c) Pitching moment

III. Balance of Inertia and Air Forces
- (a) Position of c.g
- (b) Wing loading
- (c) Altitude of spin.

Table 1a: Subheads 1 to 36.
1. Rolling moment due to rolling
2. Rolling moment due to yawing
3. Rolling moment due to sideslip
4. Yawing moment due to rolling
5. Yawing moment due to yawing
6. Yawing moment due to sideslip.
7. Pitching moment due to rolling
8. Pitching moment due to yawing
9. Pitching moment due to sideslip

10–36 Similar factors of less probable importance.

these represent very nearly the limit obtainable, for the main couple which tends to flatten it (the inertia pitching couple) has a maximum value for an attitude of 45 deg and becomes very small for small angles, while at the steep end, the airplane could not have an attitude much closer than 30 deg to the vertical and remain stalled The mean angles of attack at the center of the wings therefore, vary from about 30 deg for the steepest spins to about 60 deg for the flattest The difference in angle of attack from one wing tip to the other is great in any spin, this difference varying about 20 deg in a slow spin to about 70 deg in a rapid one, the average being in the neighborhood of 35 or 40 deg

Referring again to Fig. 1, Mr Weick pointed out that the tail unit deserves special study With an angle of attack from 30 to 60 deg, combined with a sideslip in the neighborhood of 20 deg, the fin and rudder are usually almost entirely in the wake of the horizontal surfaces In spite of this the rudder seems to be the most effective of the controls for coming out of a spin This may be explained by the fact that rudder is the only control not stalled, and by the effect that the rudder has on sideslip

At this point, Mr Weick mentioned methods of spinning research other than flight tests, including the dropping of scale models and the wind tunnel test In this connection, he spoke of the new vertical wind tunnel which has just been completed at Langley Field Mr Weick then presented a table (Table I) outlining the factors affecting the spin and went over the outline briefly, indicating which items already had been investigated in England and in this country. There were approximately twenty of the 800 factors

In summarizing, Mr. Weick stated that the spinning problem is made up of a multitude of factors, the relative importance of which must be determined before the solution of the problem can be considered well under way Some progress has been made, however, for we can now at least measure what a spin is and calculate the inertia forces and couples While the problem is still a large one, it seems more hopeful now than it has been before, because of the new developed method of measurement in flight test The vertical tunnel, where the effect of the tail group can be studied in detail, also will contribute much to the investigation and ultimate solution of the problem Following his paper, Mr Weick presented a short motion picture reel showing flight tests and model dropping tests, conducted by the N A C A

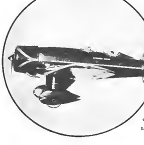
There was no discussion following the presentation of the papers constituting the spinning symposium but a motion was made by Mr Temple Joyce that the N A C A and Mr Weick be congratulated on their systematic program of attacking the problem

Although not a part of the spinning session, it is appropriate that some mention be made of the paper on flight research read by Mr J W Crowley, Jr, also of the National Advisory Committee for Aeronautics This paper might be considered as closely related to that of Mr Weick's because of the fact that it described the instruments and methods used by the N A C A in its flight research work Mr Crowley confined his remarks to two types of investigation which he terms "maneuverability" and "spin" He spoke of the numerous problems arising in connection with the development of flight recording instruments, particularly that of elimination of acceleration effects in the recording mechanism

THREE LOW WING MONOPLANES

By
Leslie E. Neville
Technical Editor of AVIATION

Comparison and descriptions of representative machines having similar aerodynamic but different structural characteristics



Colonel Lindbergh flying a Wasp powered Lockheed Sirius

THREE low wing monoplanes having different structural characteristics but many similar aerodynamic qualities were introduced recently to the aeronautical industry. These airplanes reflect the rather distinct trend toward the low wing type and embody practically all of the known methods of attaining aerodynamic efficiency through cleanness of design. Two of them, the Buhl Airster CA-1 and the Lockheed Sirius, are designed for racing, private or commercial use, while the third, the Boeing Monomail, is intended exclusively for commercial freight and passenger transportation. All three airplanes have given very creditable performance.

Considering these three designs in order of weight, we have first, the Buhl Airster employing the Wright J-6 300 hp. engine and having a gross weight of 2,800 lb.; second, the Lockheed Sirius powered with the Pratt & Whitney Wasp Sr. engine and weighing 4,600 lb. gross; and finally, the largest, the Boeing Monomail designed around the Pratt & Whitney Hornet of 575 hp. and having a gross weight of 8,000 lb.

Structurally there is a rather interesting comparison between the wooden Lockheed, the metal Boeing with the composite Buhl standing between. The Sirius, like its predecessor, is built almost entirely of wood, while the Boeing is all-metal. Representing the medium, the Buhl has a welded steel tube fuselage and a wooden wing structure, both of which are covered with fabric. It is significant to note that fabric covering seems to predominate in this otherwise widely divergent structural group.

Attention is also drawn to the fact that the structural differences between the Lockheed and other airplanes of this group necessitate a different method of mounting the wing to fuselage. In the case of the Lockheed Sirius the wing is built in a complete single unit, whereas in the Buhl plane two wing panels are attached to stubs which are structurally a part of the fuselage. The Boeing Monomail, like the Buhl, has wing stubs integral with the fuselage.

The Boeing and Lockheed employ cantilever wings while the Buhl is externally braced.

As previously mentioned, the airplanes are all low wing type with a high degree of attention paid to the streamlining and general reduction of drag. All three have wings tapered in thickness and, with the exception of the Buhl, in plan form. There is another point that immediately suggests itself in considering the three airplanes aerodynamically and that is the fuselage length with relation to the span. In this respect the Buhl and Boeing appear to be similar, while the Lockheed has a relatively short fuselage. It is significant to note that the Sirius fuselage is one inch shorter than that of the Buhl, while the span is 5 ft. 10 in. greater. A comparison of some of the general characteristics of these three airplanes is presented in Table I.

In the comparative study of these low wing monoplanes an opportunity is afforded to consider the various commercial adaptations of the N.A.C.A. type of low drag radial engine cowling. Each has a different type and the recently developed combination of cowling and exhaust manifold is also applied in these designs. The cowlings will be described in greater detail later.

TAKING the lightest of these three planes as a point of departure, we will first describe the Buhl Airster in some detail. The CA-1 as it was introduced at the All-American Aircraft Show in Detroit last April was a mail plane having the forward cockpit cowled over for baggage and a single pilot's cockpit at the rear. It has a wing span of 37 ft. and a chord of 81 in. remaining virtually constant throughout the span. The weight of the airplane empty is 1,877 lb. and the gross weight 2,800 lb. giving a wing loading of slightly more than 13.5 lb. per sq.ft. and a power loading of approximately 10 lb. per hp. The wing has an area of 206 sq.ft. including ailerons and employs the M-12 section. Structurally the wing is built up of spruce and veneer spars and ribs. The spars are of the box type using two-ply veneer perpendicularly grained, while the wings are of conventional construction. The fabric covering is applied in the usual slip cover method. Ailerons are of similar construction to the wing and have a combined area of 21 sq.ft.

The Airster was developed under the direction of Etienne Dormoy, chief engineer of the company, with the co-operation of Jimmy Johnson, test pilot and sales manager.

Welded chrome molybdenum steel tubing ranging in diameter from ½ in. to 1¼ in. is employed in the fuselage structure, the forward portion of which is cowled with aluminum alloy sheet to a point behind the pilot's cockpit. From there to the extreme tail the structure is faired with aluminum alloy in U-channel section members extending fore and aft over wood boxing. This fairing at the rear makes it possible to preserve the well rounded exterior section that was obtained with aluminum alloy covering in the forward portion. The faired portion of the fuselage is, of course, covered with fabric. No departures from the use of conventional welded chrome molybdenum steel tubing are found in the structure of the empennage. The rudder area is 14.5 sq.ft., while that of the fin is 6 sq.ft. The elevator is 22 sq.ft. while that of the stabilizer is 14 sq.ft. Stabilizer is adjustable through a range of 2½ deg.

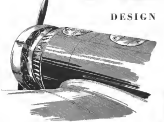
One of the novel features of the Buhl Airster is the somewhat unusual landing gear, which has an exceptionally wide tread of 9 ft. This landing gear is of the divided axle type with vertical shock absorber struts connecting the wheel with the wing stubs. Behind the shock strut on each side and directly below the forward cockpit is a triangular trussing, the function of which is to provide anchorage for four streamline flying wires, two attached to each wing panel at the spars. As the wheels are enclosed in streamline fairings, these wire braces are connected through holes in the fairings. Certain of the members of the truss serve incidentally to carry the brake control cables running from the cockpit to the wheels. All members of the landing gear are streamlined and the unit is attached in the usual manner to the wing stubs which are integral with the fuselage.

Another unusual feature in the undercarriage is the tail skid. This unit is extremely simple and effective. It consists essentially of two tubular members pivoted near their centers, one being built into the fuselage longitudinally and the other carrying the spoon shaped shoe. The shock cord is wrapped around the forward end of both members, resulting in a tension type shock absorber.

The first Buhl Airster had a fuel capacity of 80 gal. divided among two 30 gal. gas tanks in the wing stubs

Above: The Buhl Airster powered with a 300 hp. Whirlwind engine. Below: The Hornet powered Boeing Monomail

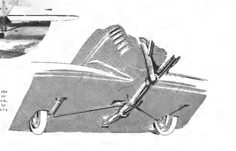
DESIGN FEATURES OF THE BOEING MONOMAIL



The two forward baggage compartment doors cowling installation and wing attachment of the Boeing Monomail

Front view showing landing gear in ground position

A rear view showing empennage lay-out and bracing as well as the tail wheel



Landing gear of the Monomail in retracted position. Note the fairings behind the wheels

and one 20 gal tank just forward of the fire wall An oil tank having a capacity of 7 5 gal in the extreme forward portion of the fuselage and just behind the engine is provided. This container was fitted with a finned bottom extending below the fuselage contour, and baffling built into the tank served to force the oil through the cooling corrugations Several different positions of the oil cooler have been tried, the most recent being considerably below the fuselage

The second of these planes is to have a total capacity of 100 gal. gasoline obtained by increasing the wing stub tank capacity from 30 to 40 gal.

The N A C A cowling is so designed that a streamline exhaust ring carrying the lines of the cowling is set just ahead of the cowling proper. These two units are separate but so carefully streamlined that at first glance they might appear to be one Another departure from standard practice is found in the internal design of the cowling The baffle plates between the cylinders are generally V shaped with the apex of the V forward and the legs of the V curved around behind the cylinders This arrangement is intended to produce an increased pressure of air as it is forced through the cylinder fins

Landing wires are attached to center fittings at the top of the fuselage, while flying wires are attached to a portion of the landing gear units

Work is now being done by the Buhl engineering staff under the direction of Etienne Dormoy to eliminate the two landing wires in the external bracing

The second in order of weight is the Lockheed Sirius, developed during the latter part of 1929 as a custom built product to meet the requirements of Col Charles A Lindbergh. Although at that time there was no expectation of a wide demand for this model, a number of them have been built and delivered since and the design has become noteworthy in several record flights. The Sirius has a wing span of 42 ft 10 in. length overall of 27 ft. 6 in., and an overall height of 9 ft The weight empty, including 900 lb. for the power plant is 3 056 lb and the gross weight 4,600 lb giving a wing loading of 17.35 lb per sq.ft and a power loading of 10 2 lb per hp

Practically all of the component parts of the Sirius are identical with those of its predecessors in the Lockheed line The fuselage is standard, having been formed in the same mold as the earlier Lockheed planes, and the wings and tail surfaces vary only slightly in dimensions Structurally the Sirius might be considered as being made up of the same units as the standard Vega model with the wing mounted beneath instead of above the fuselage The Sirius wing has a pronounced dihedral angle however, while that of the Vega is flat Fin and rudder areas have been enlarged in the low wing model. Credit for the design must be divided among John K Northrop, Lockheed chief engineer in 1926, who perfected the original design in collaboration with Allan Loughead; Gerald Vultee, former chief engineer under whom the Sirius model was perfected, and Richard Von Hake, present chief engineer and contributor of recent refinements and improvements

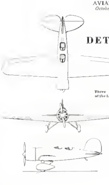
The Sirius wing has a dihedral of 2 deg measured on the top surfaces and 5 deg on the bottom surfaces The wing is set at an incidence of 1 deg The wing is tapered in plan form and thickness, the maximum thickness at the root being 18 in and at the tip 8 in The chord varies from 8 ft 6 in at the root to 5 ft 6 in. at the tip and the mean aerodynamic chord is 84 7 in The center of gravity is located at 34 per cent of the mean aerodynamic chord A normal Clark Y airfoil section is employed at the tips and somewhat varied at the root.

Structurally the wing is similar to that of the Vega but, because of the span which is greater by 1 ft 10 in. and of the slightly higher wing loading additional spruce cap strips are incorporated in the spars These spars, which are otherwise identical with those of the Vega except for the built in dihedral, are of conventional box type with taper laminated spruce cap strips solid spruce filler blocks at points of attachment and vertical spruce filler strips to stiffen the two-ply spruce plywood side plates in which the grain of the veneer runs at a 45 deg angle in each direction from the spar axis The additional cap strips are nailed and glued to the box spar above the plywood webs A cat walk is built into the top of the wing along each side of the fuselage and consists of an extra layer of plywood nailed and glued on

TABLE I COMPARATIVE TABLE OF LOW WING MONOPLANE SPECIFICATIONS

	Buhl CA-1	Lockheed Sirius	Boeing Monomail
Dimensions			
Span	37 ft.	42 ft. 10 in	59 ft. 1½ in
Length Overall	27 ft. 7 in.	27 ft 6 in.	41 ft. 2 in.
Height Overall	8 ft 3 in	9 ft.	—
Chord (max.)	81 in	8 ft. 6 in	12 ft 4 in
Chord (min.)	81 in	5 ft 6 in	7 ft. 6 in.
Incidence (deg.)	1½	1	
Dihedral Upper Surface (deg.)	3	2	
Dihedral Lower Surface (deg.)		5	
Airfoil Section	N A C.A. M-12	Clark Y mod.	—
Power Plant			
Engine	Wright J 6	P & W Wasp	P & W Hornet
Horsepower	300	425	575
Weight (lb.)			
Structure and Equipment		2,156	
Power Plant		900	
Weight Empty	1 877	3,056	4 610
Useful Load	923	1 544	3 390
Gross Weight	2 800	4 600	8 000
Wing Load'ng (lb per sq.ft)	13 5	17 35	
Power Loading (lb per hp)	10	10 2	13 9
Areas (sq ft.)			
Wing (including ailerons)	206	265	—
Ailerons (both)	21	25	
Stabilizer	14	39	
Elevators	22	23½	—
Fin	6	12½	—
Rudder	14 5	10	

DETAILS OF THE LOCKHEED SIRIUS



Three view drawing of the Lockheed Sirius

over the plywood wing surface which is reinforced at this point by stiffener ribs. Ribs are of the truss type constructed of spruce with plywood gussets and are built in three parts, namely, the nose, center and rear sections.

The two spars and center ribs are first assembled, the nose and trailing ribs then being glued and nailed in place and the entire wing covered with plywood, which is glued and nailed in place with barbed and coated brass nails. The interior of the wing is treated with Lionoil while the exterior is sprayed with several coats of primer and lacquer paint.

Frise ailerons with a differential action producing an upward travel double the downward travel are mounted with a 16 per cent balance. Structurally the ailerons are similar to the wing and their combined area is 25 sq ft.

One of the new features of the Sirius is the retractable wing hit lugs. These lugs, which in previous models were exposed to the air stream, are now made flush with the top surface and provided with a small wire by which they may be brought up into the service position for use. Retractable landing lights, two of which are normally provided, have been developed by Lockheed engineers working in conjunction with the technical staff of the S & M Lamp Co. These lights may be adjusted to any one of thirteen positions ranging from full vertical to full horizontal ahead and, when fully retracted, are flush with the lower surface of the wing. With a special 15 ampere General Electric bulb and a special S & M reflector each lamp develops 18,000 c.p. from a 12 volt storage battery.

These retractable features are representative of the constant efforts made by Lockheed engineers to reduce parasite drag. As in the case of its predecessors, the Sirius employs full cantilever wings and tail surfaces and the monocoque fuselage is of excellent streamline form. Standard Lockheed fuselage construction practice is described elsewhere in this issue. There are no exposed struts or brace wires anywhere in the airplane with the exception of those necessitated by the landing gear, and engineering work is now in progress to produce a retractable landing gear for use in connection with the Sirius.

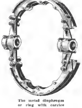
Tail surfaces are of spruce and plywood construction similar to the wing and fastened to the rear of the fuselage shell by means of a heavy aluminum alloy casting which is bolted in place at the rear tip of the fuselage after the slot has been cut for the mounting of the horizontal stabilizer. The stabilizer is hinged at the rear spar to plain bars on the aluminum alloy ring, while the leading edge is carried in a rack and gear adjusting mechanism mounted on the tail skid diaphragm forward of the cutout. The fin is supported by a heavy laminated spruce spar extending down along its trailing edge completely through a hole in the stabilizers to mountings in the top and bottom of the aluminum alloy casting where the fin spar is securely bolted in place. The leading edge of the fin is bolted to the tail skid diaphragm. Elevators are independently mounted to the stabilizer, while rudder is carried on an upper hinge to the fin and on a rudder post which extends down through bearings on the same aluminum alloy ring mount to which fin and stabilizer are attached.

The present landing gear of the Sirius is of the standard individual tripod type with vertical shock strut units and has a tread of 12 ft. Bendix wheel and brake units with Goodrich 32x6 in. tires are employed. The shock absorber unit is a special combination spring and Oleo strut using aluminum alloy streamline tube fairing as a strength member, thereby saving 12 lb. The weight of each of the present strut units is 22 lb. These struts contain three springs in conjunction with an oil piston, providing a total travel of 6 in. They have been adopted as standard by other manufacturing units of the Detroit Aircraft Corp.

Each wheel of the landing gear is almost completely enclosed in a streamline fairing, which is bumped out of aluminum by hand in two halves which are later welded together. These units weigh 25 lb. each and are mounted securely to the axle on the outside and to the brake drum on the inside of the wheel. In addition to the wheel fairings and the streamline shape of the shock strut itself, the strut is faired into the lower surface of the wing by a separate hand bumped aluminum fairing fitted at the point of strut attachment. Aluminum alloy sheeting is used to fair the axle to the brace strut on each tripod and these strut fairings are in turn faired to the under side of the wing by means of a special streamline fairing unit. Other hand bumped aluminum fairings weighing approximately 3 lb. each are used to streamline the wing to the fuselage and the stabilizer and fin to the fuselage.

The engine mounting is a steel tube ring having ten tubes extending back to five points of mounting on the forward laminated spruce diaphragm of the fuselage shell. A laminated aluminum and asbestos fire wall is installed completely across the fuselage in the rear of the engine mount and across the front side of the forward diaphragm so as to protect the wooden fuselage from any fire in or around the engine. The fire wall is built up of two sheets of aluminum .040 and .032 in. gauge between which is a layer of asbestos. The entire fire wall unit within the diaphragm is removable from

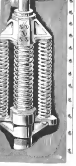
Front spars for the Lockheed Sirius. The complete member is shown above while the spar structure without front plate is in the center. The plywood plates may be seen on the assembly table



The metal diaphragm or ring which carries the tail assembly in the Lockheed Sirius

The Lockheed quick acting dump valve which is soon to be produced by Detroit Aircraft Products Corp.

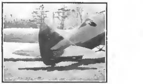
The Sirius fuselage at the fire wall showing normal gasoline and oil tank installation and fuel lines and valve. The centre portion of the fire wall has been removed



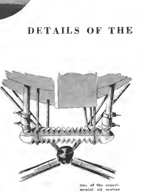
Details of the spring portion of the standard shock absorber strut which has been adopted as regular equipment on all Lockheed planes including the Sirius

A general view of the airplane as it appears in flight position

DETAILS OF THE BUHL AIRSTER CA-1

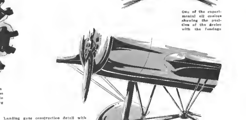


Empennage and general tail form of the Airster



One of the experimental oil coolers showing the position of the device with the fuselage

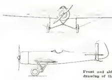
Sketch showing construction and form of baffles used in the Buhl cowling



Landing gear construction detail with wheel fairing and external wing bracing

the inside of the fuselage to provide easy access to the rear of the engine

Within the fuselage and just behind the fire wall a 15 gal oil tank is mounted to transverse steel tube members near the bottom of the fuselage by means of flat duralumin strips 1 in $\times \frac{1}{16}$ in and lined with felt The oil tank filler neck is so placed that if the plane is on level ground it is impossible to place more than 15 gal of oil in the tank, insuring a 2 gal foaming space at all times An oil cooling feature has been incorporated in recent tanks, consisting of a corrugated transverse tube running through the tank and through which air is drawn in from the left and discharged at the right side If the oil is warm, cold air is drawn through, and if the air is cold, hot air is drawn through, a flutter valve controlled by the pilot making it possible to draw air from the outside or from the exhaust manifold



Front and side view drawing of the CA-1

An 81-gal fuel tank is mounted within the center section of the wing in cradle straps of felt-lined aluminum alloy, the filler neck extending out into the fillet which fairs the wing to the fuselage A 72-gal fuel tank is carried in the upper forward portion of the fuselage suspended from steel tubes extending laterally between two diaphragms and supported by felt-lined duralumin straps Piping and fuel valves are so arranged that fuel may be run from either tank to the engine or to the other tank Valves, strainers and wobble pump are all located at the forward lower right hand side of the fuselage and are controlled from either cockpit by means of hollow tube pushrods Although the engine is normally supplied with fuel by means of an engine driven pump, the upper fuel tank will feed by gravity and fuel may be pumped by hand from the lower tank to the upper or to the engine

In connection with the fuel system a novel and effective dump valve has been developed and is to be produced by the Detroit Aircraft Corp for supply to other aircraft manufacturers and fuel tank builders The valve, which will dump a 255-gal fuel tank in 30 sec and then may be immediately closed, consists of a disk seating against a cork gasket on the bottom of the tank and controlled by a rod running up through the tank to a cam mechanism on the top This cam arrangement makes it possible to open and close the valve readily and repeatedly, and an adjustment is provided to maintain gasoline tightness

All engine controls are operated from the cockpit by means of push and pull rods extending down the left side of the fuselage and all controls may readily be inspected at both the cockpit and the engine Immediately behind the fuel and oil tanks is the baggage compartment, which is constructed of aluminum alloy sheeting mounted to side frames of flat bent duralumin and to floor members of duralumin supported by beams attached to the fuselage diaphragms A Hamilton Standard metal propeller is regular equipment and has a diameter of 9 ft and a pitch of $20\frac{1}{2}$ deg at the 42-in station An Eclipse combination hand and electrical inertia starter is also standard equipment and uses current supplied by a 12 volt Exide battery

Inner cowling of smooth bumped duralumin is provided between the engine crankcase and the fuselage proper, while a complete cowling of standard N A C A type encloses the engine Dimensions of the outer cowling range from 53 in in diameter at the circular forward portion to a depth of 60 in and a width of 49 in at the rear of the skirt where it conforms to the oval shape of the fuselage

The N A C A cowling weighs 40 lb and is constructed in two main sections joined along the top and bottom The nose portion is bumped out of aluminum sheet by hand and riveted to the flat duralumin skirt of the rear portion of the cowling The skirt is supported at the rear by projecting stubs from the fuselage which fit into holes in the cowling and are held in place by pins A steel ring extends completely around the engine at the front and the cowling is mounted to this ring by means of projecting stubs which engage holes on the cowling The two halves of the cowling are joined together by two quick acting clamps at top and bottom and by a piano type hinge around curved nose portion, top and bottom, with the piano wire bolted in place at the leading edge of the cowling

Detailed description of the internal arrangement of the Sirius is complicated by the fact that each plane so far constructed has been individually designed to suit the requirements of the purchaser The first Sirius delivered to Lindbergh was provided with two cockpits fitted with an adjustable and removable enclosure and was equipped to carry 440 gal of fuel The machine built for Art Gobel carries 818 gal of fuel and has but one cockpit Another plane recently delivered has a two-passenger cabin forward and two cockpits with adjustable enclosure aft Unless otherwise specified, however, the Sirius model is furnished with two open cockpits above and behind the wing, a fuel capacity of 152 gal and a baggage compartment for 250 lb The two cockpits are located in the rear of the baggage compartment in the standard model In the special models, of course, the entire forward portion of the fuselage, as well as a good portion of the wing, is devoted to fuel tank housing Each cockpit is provided with a parachute seat of the bucket type and built with sheet duralumin padded and upholstered in leather The seat is suspended on a rubber shock cord and held in place by two approximately vertical tubes The pilot's position may be readily changed by moving the seat up or down in the tubes and clamping it at any desired point Dual controls are standard equipment

Complete instrument equipment is furnished in the front cockpit of the standard model, while the rear cock-

pit contains only the more important instruments. Navigation and landing lights are standard equipment and all circuits are equipped with fuses accessible from the front cockpit. A hand fire extinguisher is provided in each cockpit and a pressure system controlled from either cockpit extends forward to the engine compartment.

Control wires and pulleys are placed beneath the plywood floors. Ailerons are controlled by wires running over micarta pulleys to a balanced lever within the wing from which a push pull tube extends an operating arm on the aileron. This entire mechanism lies within the wing. Rudder and elevator controls are operated by double cables running over micarta pulleys, the entire mechanism being completely enclosed. Brake action is gained by rocking a foot rest which is an integral portion of each rudder pedal. An easily removable cone shaped cap completes the streamline form of the fuselage at the rear and provides ready access to the control arms of the tail surfaces. All control wires and other metal fittings are electrically bonded by copper tape. Stabilizer adjustment is accomplished through a crank and torque rod with worm gear drive, as previously mentioned, acting on the leading edge of stabilizer.

METAL construction throughout is the characteristic factor in which the Boeing "Monomail" differs from the other airplanes described in this paper. The Monomail is also distinguished by its retractable landing gear. It is an internally braced type, powered with the Pratt & Whitney Hornet engine and having a weight empty of 4,610 and an A.T.C. gross weight of 8,000 lb. The length overall is 41 ft. 2 in., and the wing span 59 ft. 1½ in. While the internal arrangement of the fuselage is somewhat variable, the first plane of this type had three mail compartments with a total capacity of 220 cu.ft. and a cockpit for the pilot. Another arrangement provides for six passengers and 1,100 lb. of cargo, while still another accommodates eight passengers and 700 lb. of cargo.

Although structural details of the Monomail have not yet been released by the company, it is known that the wing panel construction conforms with Boeing practice, the framework being square or rectangular duralumin tubing. Ribs are of the truss type and also constructed of duralumin while smooth sheet stock of the same material is used for the wing covering. Ailerons of the Frise type, hinged on ball bearings, and wing tips also are of metal construction, similar to that of the wing panels and having smooth covering. Tests on the wing structure have shown load factors higher than that for which the structure was designed in certain attitudes of flight, according to the report of the manufacturer.

Wing stubs are structurally similar to the panels and are integral with the fuselage or body. They are so designed as to house the landing gear when retracted and also contain two cylindrical gasoline tanks having a total capacity of 1.5 gal. These tanks are removable through the bottom surfaces of the wing stubs. The left wing stub serves as a walk-way for loading and unloading mail and has a hinged nose section which provides a convenient space for the storage battery, radio dynamotor and the generator control box.

The fuselage is of semi-monocoque construction with longerons, longitudinal and circumferential stiffeners, and bulkheads of square or rectangular duralumin tubing. The covering, like that of the wing, is of smooth sheet stock. The engine mount is constructed of welded steel tubing and is detachable at the firewall bulkhead. Connection to the body is made with taper bolts. The three mail or express compartments previously mentioned, and having a total capacity of 220 cu.ft., are provided between firewall and cockpit.

The retractable landing gear has a tread of 10 ft. 1 in. and is equipped with Boeing Oleo type shock absorbers and is raised and lowered by means of a hand crank on the right side of the cockpit. A special indicator to show whether the wheels are up or down is mounted on the instrument board. Rod controlled brakes are provided and may be operated from the rudder pedals, either separately or together. In addition, a hand brake is installed for locking both of the 36 in. x 8 in. wheels which are mounted on roller bearings. The tail wheel which is also mounted on roller bearings is non-steerable and equipped with a Boeing Oleo type shock absorber unit and a 9 in. by 2½ in. solid tire. The wheel is fully casted and centered in flight by means of shock absorbers under initial tension.

Tail surfaces, as in the case of the wings are of duralumin construction with smooth covering and externally braced by two steel struts below and two streamlined wires above the stabilizer. Elevator and rudder have overhung types of balances and are hinged on ball bearings. Stabilizer is adjustable in flight. Ball or roller bearings are used throughout the control system and control cables within the wings are removable without disassembling or uncovering the wings. Rudder pedals are adjustable in flight. Stabilizer, adjusting mechanism may be reached through an opening behind the rear cockpit and a stabilizer position indicator is provided in the cockpit.

The pilot's cockpit is fitted with a specially designed instrument board, having a removable center panel for flight instruments and two fixed wing panels. The center panel is a special Boeing patented flight instrument board providing means of rotation of the airspeed indicator, the altimeter and the tachometer, and having indirect lighting for night flying. The pilot's seat is adjustable in flight to a range of 7 in. and a heater is installed on each side of the cockpit approximately midway between the stick and the rudder bar. A hand fire extinguisher and signal flares are also included in the equipment.

The power plant consists essentially of the Hornet 575 hp. Series B, engine, developing its output at 1,950 r.p.m. The carburetor air intake is at the top of the cowling. The exhaust system consists of a collector ring, a carburetor air heater, and a cockpit heater. Engine controls are passed through the mail compartments and are protected by duralumin hinged covers which are easily removed. A combined hand-electric inertia starter is provided. The booster coil button and the electric starter clutch handle are so arranged as to allow operation with one hand. The engine section contains a 15-gal. oil tank, 12½ gal. of oil and 2½ gal. of expansion space being provided. Oil is cooled by air drawn from outside of the cowling through a cooler consisting of seven one-inch tubes built into the oil tank, and by passing the oil through a nose radiator. A nose shutter, operated from the cockpit is installed. Provision is made for the installation of a radio transmitter and two radio receivers directly aft of the cockpit. This equipment may be serviced from the ground through an elliptical opening in the body, covered by a hinged duralumin door. The plane is bonded and shielded throughout.

BEHIND THE SCENES OF THE NATIONAL AIR TOUR

Looking back on the problems of management of the 1929 5,000-mile air cruise as its successor nears its close

By John T. Nevill

Detroit Editor of AVIATION

SINCE the first Ford Reliability Tour, later known as the National Air Tour, took off from Ford Airport, Dearborn, late in September, 1925, it has grown to be one of the most distinctive annual events of any American industry. Its distinctiveness, in fact, is approached only by the Glidden Tour of the young automobile industry, an erstwhile classic of the open road, after which the air tour is patterned.

Yet its dissimilarity from the Glidden Tour, that is, its direct competitive features, have set it apart as unique, even against the rather novel idea from which it was derived. Each year since 1925 the National Air Tour has been held, never failing to give favorable advertisement to the industry fostering it. Each year it has had more craft entered than the year before. And in only one instance—this present year—has it failed to extend its mileage by several hundred miles. From a competition of little more than a dozen planes, carrying approximately 30 persons and covering 1,900 miles, the National Tour came in 1929 to include 40 planes, approximately 125 persons, covering more than 6,500 miles. With this growth, the attendant problems have grown. A tremendous amount of good, old-fashioned hard work, worry, and responsibility, to say nothing of the financial risk involved, lies behind the staging of any National Air Tour. Most of the pilots who have competed in the Tour realize that. Perhaps some of the executives, whose planes have been entered in the event, do not.

It is a curious fact that men who are least benefitted by the Tour contribute the bulk of the money making it possible. That is, the fund is raised by popular subscription, from business men and business houses in Detroit and in the cities to be visited by the touring planes. The theory behind this system of promotion is that all business, aeronautic or otherwise, will be benefitted ultimately through an indirect process of having one more large and "going" industry centered within the United States. Local community spirit and faith in the aviation industry, converted into dollars and cents, annually provide from $30,000 to $50,000, without which the National Air Tour probably would not be held.

The proof of the Tour is not altogether in the flying. The proof, after all, lies in smooth operation from start to finish, and the personal satisfaction of the pilots, the mechanics, the passengers, the press, and the manufacturers, not to mention more than 30 "local committees," and 1,000 or more business men who have pledged their own money to put the Tour over. While "on the wing" the Tour presents, principally, a mechanical problem. Once having stopped, it represents a human one. And it is this human problem, which starts with the solicitation of the first dollar and ends with the post-Tour payment of the last straggling bill, that squarely faces the Tour Manager and his staff.

ACCORDING to Capt. Ray Collins, who refereed the Tour for four years and managed those of 1929 and 1930, there are four major problems to be handled in staging an air tour: building the proper organization, interesting the manufacturers, financing, and executing the plans "as advertised." Each of these, of course, has its own sub-problems, such as choosing the time, choosing the route, setting the budget, helping to train the 30 or more "local organizations," publicizing the Tour, drafting the rules and formula, running off the "stick," "unstick," and speed tests with accuracy and dispatch, handling the scoring, and last, but by no means least, proper handling of the personnel while en route.

Figuratively speaking, let us "go back-stage," and look around behind the scenes in order to see how this work is carried on.

For clarity's sake it will be best to start in at the very beginning, so we will go back to approximately six months before the Tour actually begins. At that time, there is only one man left of the hundreds who helped put over the preceding Tour, and that man is the chairman of the Tour Committee in Detroit. All officials, including the chairman of the Tour Committee, are appointed, or re-appointed, annually, but the chairman retains his post throughout the "off-season" in order to overcome the inertia and give momentum to plans for the next season. This post, incidentally, has been occupied by William B. Mayo, chief engineer of the Ford Motor Company, every year since the event was inaugurated.

About six months before the Tour the Chairman be-

gins to put his plans into effect—he chooses his committee, the nucleus around which revolves the entire organization The picking of this committee, mind you, is no ordinary achievement since it is these nineteen or twenty men who must underwrite the Tour, must guarantee to raise the necessary budget or produce the difference from their own bank accounts This committee is usually made up of wealthy and influential Detroit business men, men who have amassed fortunes from the automobile industry, and are air-minded

THE VERY FIRST JOB of the Tour Committee, after it has been called together, is to appoint, or re appoint its chairman Its next job is to pick and appoint, or re-appoint, a tour manager.

Having chosen a manager the tour committee promptly "takes a back seat," and allows the manager to "start the ball rolling." One of the initial jobs of the manager is to draw up three, or possibly, four proposed routes over any one of which the coming Tour might well travel These routes are usually designed to take the Tour where, in the judgment of the manager, it is most needed These proposed routes with several suggested dates, and other data relative to the forthcoming event, are then submitted to the manufacturers This year this questionnaire went out to more than 160 manufacturers From the returns on the questionnaire, the manager usually can formulate some idea as to what route a majority of the manufacturers want to take as well as some idea as to how many planes he can expect to start the Tour Having this knowledge and having the benefit of past experience, he can then arrive at some figure in the neighborhood of what the Tour will cost, as well as approximately how many men he will need in his working organization All of this data he then presents to his Tour Committee.

In the meantime, also, the tour manager, in close co-operation with his committee, has selected a rules committee, a contest committee, a referee, a scorer, a starter, a chief timer, a weigher, an assistant manager, and a manager's secretary

Before passing too far away from the subject of money it might be best to elaborate a bit on just how the Air Tour budget is determined and how it is raised. We have already shown that the tour manager has a fair idea of the number of planes that will start from Ford Airport From past experience, he knows approximately how many accompanying planes on the "expenses paid" list there will be. He can guess pretty well at the number of persons he will have to take care of and just about how long he will have to take care of them He knows pretty well what the Tour's approximate mileage will be, so he can calculate fairly closely the cost of gasoline and oil He sets aside so much for prize money, so much for salaries within his own office, so much for office supplies, so much for advertising and posters, so much for telephone and telegraph tolls, and so much for traveling expenses, including the pathfinding trip over the proposed route He adds $5,000 or so to these figures for safety.

It might be interesting to know, while we are on the subject, that Captain Collins' budget for last year's Tour was $38,000 A total of $15 000 of this was paid out in prize money, $8,000 for gasoline and oil, $800 for office salaries, $440 for the pathfinding trip (two men in an airplane, 5,000 miles), $3 000 for advertising and publicity (including the posters furnished to cities over the route), $1,000 for telephone and telegraph tolls and postage, $450 for maps $3 500 for Detroit hotel bills (approximately 100 persons, 5 days previous to Tour and 2 days after competition of Tour), $1,650 for Tour banquet following the finish

By this time about four months will have passed and the Tour is only two months away The rules have been adopted The manager's various appointments have been approved The proposed route has been selected Contact men in cities over the proposed route have been established These contact men have organized their local committees, and, by means of written instructions mailed from Detroit they have some idea as to what they are supposed to do The budget has been approved and operating expenses have been gained from the donations of Tour Committeemen themselves

Then, while the assistant manager remains in Detroit and devotes most of his time to the task of raising the budget, the tour manager and referee make a quick "pathfinding" trip over the proposed route, making personal contact with the local organizations, seeing that they have properly started training the local timers, checkers, etc, checking up on arrangements for hotel accommodations and transportation from and to the airport, inspecting the airport itself, and making clear the details of finance and service

Each city designated as a noon-day stop has been required to contribute $500 to the Tour fund as well as furnish lunch for the Tour personnel Similarly, every city named an overnight stop had to put up $1,000 and pay the personal expenses of the pilot and mechanic of every competing or official plane as well as the Tour officials

Under the very able direction of Louis Firsht, assistant manager, the Detroit campaign of 1929 was carried out in the following manner.

ABOUT ONE MONTH before the scheduled start of the Tour, the tour manager's office mailed out the first of a series of three letters explaining the importance of the Tour and emphasizing the advantages of having it begin and end in Detroit. These letters, approximately one thousand in number, were written over the signature of Frank W. Blair, president of the Union Trust Company, who was chairman of the Tour Committee's finance group They were addressed principally to executives of various manufacturing companies within the Detroit area many of whom have contributed to the Tour fund annually A card file was kept in the manager's office, each card bearing the name of some individual or firm to whom the first letters were mailed When replies were received the respective cards were pulled from the file and the information recorded thereon In case of receipt of donation this information prevented the mailing of a second letter, mailed about one week later to those from whom replies had not been received. Immediately upon receipt of donations this money was placed in a trust fund subject only to a voucher carrying the signature of the Tour Manager and countersigned by the Trustee Since all bills are paid as soon as they are received, it is necessary at times to withdraw small portions of this money

As soon as sufficient money has been raised to take care of the cash prizes, this sum is withdrawn from the trust fund and placed in a prize fund, where it remains until after the Tour and is withdrawn under signature of the tour manager and a representative of the National Aeronautic Association Meanwhile, the Tour Committee has been meeting periodically, during which meetings

the manager advises them as to progress of the campaign

While all this has been going on preparations are being made for the pre-Tour tests at Ford Airport The Rules Committee and the Contest Committee have been selecting and training their crews and seeing to it that the proper material and equipment is on hand at the airport Meanwhile, also, the new rules have been printed and mailed out, entries have been received and publicity has begun to find its way into the columns of newspapers and magazines over the United States

There is no more important step in the Tour's preparation and execution than the "stick," "unstick," and (in 1929) speed tests, and the load determinations at Ford Airport previous to the takeoff The fair, impartial, and congenial handling of the pilots from the time the first arrival lands on the port until the starter drops the flag on Entry No 1, the courtesy and accuracy shown in taking these all-important performance figures, and the smooth and thorough dissemination of all information pertaining to the rules allowed practices, prohibited practices, privileges, etc, is the Tour's best insurance against dissatisfaction, ill-feeling, and protest Prior to this year, barring accident or excessive engine trouble, the Tour was practically won or lost during these tests Fortunately, they usually are carried out with all possible efficiency and consideration At least, the writer recalls no written protest ever having been filed as an outgrowth of the pre-Tour trials

WITH AN EXPERIENCE RECORD of four previous Tours to guide them, Captain Collins and the Contest Committee of which the late Captain L. M Woolson was for several years the chairman, put the pre-Tour trials through with as much efficiency and dispatch as the most critical observer could reasonably expect True, the trials of some of the entries unfortunately were delayed, but that could be charged entirely against the weather It is the duty of the Contest Committee to see that the rules of the Tour are adhered to, and it is that committee that conducts the pre-Tour tests

In weighing in the Tour entries this year and last, Manager Collins inaugurated an entirely new practice in that work The Department of Commerce allowable useful load was taken arbitrarily as the entry's Tour Contest Load That load, pilot, passengers, fuel, tools, spare parts, sand, etc, then was built up on the scales It was the duty of the checkers over the entire route to see that the proper load, or its equivalent was maintained

The taking of stick, unstick and speed records, however, was not so simple a process The weather element enters into those things and, as every pilot knows, the weather has an incorrigible way of playing favorites But, in order to compensate for the weather as much as possible, and in the interest of almost absolute accuracy, here is how those tests were carried out

On the speed tests, when they had to be made, the contestants were required to fly two times each way (with and against the wind) over a measured mile course Telephone booths and sighting wires were installed at each end of the course, each end being manned by two timers equipped with stop watches Four times were accordingly taken for the mile course These times were averaged and computed into miles per hour, which figure went into the formula as applied to individual planes In the landing and take-off trials each contestant was allowed two trials both of course, being against the wind, then permitted to choose the best marks set In order to avert any possibility of handicapping any pilot on a muddy field, the airport's concrete runways were used for this purpose Following completion of these tests the figures to be used were immediately turned over to the scorers that they might compute each pilot's figure of merit that all important numeral in the National Air Tour

THE NATIONAL AIR TOUR "on the move" presents a number of somewhat vexing problems, some of which are carried over from the preliminary preparatory work, but most of which are characteristic of travel Prominent among them we find automotive transportation to and from the various airports, hotel accommodations, scoring, weather, publicity, and the safeguarding of the public from the planes as well as the safeguarding of the planes from the public

Broadly speaking, the air tour contestants take off from the starting point in the order of their respective entry number. From each lunch stop they take off in the order of their arrival at that point, and from each overnight stop they depart in the reverse order of their arrival the afternoon before This latter practice was very wisely placed in effect several years ago in order to give the slower planes an opportunity to arrive at the lunch-stops at about the same time as the faster entries Although the custom varies from year to year, during the recent Tour the manager, the referee, and the scorers departed from each control point an hour or so ahead of the competing planes in order to arrange for a proper reception at the next point The starter, of course, remained behind until all of the competing craft, or at least those that are ready to start, are underway It remained between the manager and the referee to see that the local committee was properly prepared to meet and take care of the incoming planes and personnel, to see that sufficient timers and checkers were on the field to time the craft in and to check their loads, and to direct them to their proper parking spot on the airport, as well as to act as a "reception committee" to the occupants of the plane to which each individual checker was assigned If the stop was an overnight one it was up to the manager to see that sufficient transportation was provided by the local committee to transport the Tour personnel into town and back again the following morning It also was his function to see that hotel accommodations were provided for, and that each member of the Tour party was taken to his hotel within a reasonable length of time after arrival at the airport. The referee, usually remained at the airport to direct the checkers and to be on the lookout for violations of the Tour rules in order that he might be fully equipped to pass upon the case in his capacity as a member of the Contest Committee

The foregoing and many other lesser but just as urgent duties necessarily have to be accomplished with as little friction and delay possible at each stopping point The human element enters so much into this work that it would not be fair to hold the manager and the referee accountable for every slip from smooth operation encountered Each year the Tour management profits by the mistakes made during the previous year and it would seem to the writer that the most recent Tours offered less scope for criticism than any National Air Tour previously held

While the major portion of the responsibility on the National Air Tour may rest upon the shoulders of the Tour manager and referee, all of those who have accompanied the event perhaps will agree that the scorers have

the most difficult job of all That is, their work comes nearer to being never ending than the job of any official of the Tour And, incidently, the responsibility such work carries with it is obvious

On more than one occasion the scorers have been kept hard at their task way into the night, too busy computing, checking, and re-checking scores to participate in much of the nocturnal activity that would come under the classification of "entertainment" Fortunately much of their work is done by means of machinery, otherwise, considering the number of contestants, the work would hardly be physically possible

Upon arrival at each control point the chief scorer usually sits at the timers' table placed on the field at a right angle to the chalked finish line and jots down the exact time each entry crosses that line From Pop Cleveland, the starter, he later secures the exact time of each departure If the Tour planes begin taking off at the time they are scheduled to do so, Mr Schlosser already knows the departure time of each plane and does not have to wait for that information Having then the elapsed time for each plane, and previously having determined the full elapsed time allowed each contestant for flying each leg of the route, the scorer knew at a glance, until this year which contestants are to be credited with their full "figure of merit" for a "perfectly" flown leg, and which contestants are to be scored on a basis of their actual speed The new formula taking the actual speed on each leg of the course has made it more complicated

To quote E P Crocker, statistician and assistant scorer, regarding his work last year

"Mr. Schlosser and myself received the timers' figures on the speed tests and the stick and unstick tests at 6 o'clock on the night before the start Taking these figures to the hotel we worked all night with a Marchant electric calculating machine, computing the figure of merit for each contestant by formula, the speed to be maintained by each contestant (85 per cent of the top speed), and the allowable time for the distance to be covered on each leg of the Tour.

"The formula was computed and proved step by step with locked figures and visible factors for running proof Advance entry then was made in pencil on the score sheet of the figure of merit for a perfect score for each contestant These entries and the sum of all of them were carried forward several days on the natural assumption that every contestant should normally make his time, leaving only a relatively small number of scores to be re-computed

"Next, the tests for speed were reduced to miles and decimals of miles per hour Eighty five per cent of each of these speeds was computed, and from this figure was computed the allowable seconds per mile for each contestant The allowable seconds per mile were figured to the thousandths in order to give each contestant every second of time to which this speed test entitled him Entry of allowable seconds per mile was made on the master sheet, or score sheet in a column alongside that reserved for the respective figures of merit Then, the allowable seconds, being a constant in each pilot's case, were locked in the machine and multiplied by the mileage for each leg of the Tour One click of the machine then computed any one pilot's allowed seconds for covering 100 miles, a shift and a click, 90 miles, a shift and a click, 96 miles, a shift and a click, 991 miles, etc., etc. Thus, without a clearance and all as one operation, the total seconds allowed any one contestant for covering each of the 32 distances to be flown was computed and entered on the master sheet in the proper columns These figures were left for later reduction to hours, minutes and seconds, as required on the logs

'The reduction of seconds to hours, minutes and seconds was handled mechanically, also, by putting into the calculating machine the total number of seconds allowed any one pilot for flying any one lap After this had been done, the numeral 940 (the complement of 60, plus a 9 for carry over) was set up on the keyboard, and the allowed seconds divided into minutes and seconds, after which the minutes were divided into hours and minutes Thus, by purely mechanical operation, and without a clearance, we obtained the necessary hours minutes and seconds with the chance of error, reduced to that of reading and pencil entry only Each pilot was later given a memorandum of his allowable seconds per mile to enable him to check in advance the accuracy of the allowable time entries on his log

"Next we computed the formula as applied to each contestant on a basis of a speed of one mile per hour, securing thereby a 'figure of merit' for unit speed This, also, was entered on the master sheet After each hop we received from the timers the actual elapsed time for each contestant Since the figures of merit for perfect scores already had been entered for several days ahead we were not concerned with those contestants who had flown the leg within their allowable time although their actual time was entered on the master sheet as a matter of record From the standpoint of calculating scores we were however, concerned with the unfortunate pilots who failed to fly over the finish line within their allowed time From their actual time we computed their miles per hour and multiplied this figure by their respective figures of merit for unit speed This, of course, gave us thir score for the lap 'imperfectly' flown.

"This was followed by erasure of the perfect score total already entered in pencil on the master sheet, entry of the actual score for that leg, and entry of the new total score at that control point Thus, the entry of the actual score for the hop 'imperfectly' flown served the double purpose of an easily located memorandum of each failure to make the time and a check figure for later proof of accuracy By this method of advance computation it was possible to turn out an accurate complete score within a very few minutes after receipt of the figures on elapsed time from the timers' stand"

Before closing, some mention should be made about the method of scoring the "stragglers" When a pilot, for one reason or another, is delayed and falls a day or more behind the main entourage it is obvious that his arrival and departure times at the various control points and his leg by leg scores cannot be posted on the master sheet until he has rejoined the Tour Such arrival and departure times usually are obtained by some member of the local committee delegated to remain on the airport until the "straggler" checks in The local committeeman then wires the information to the chief scorer in care of the Tour.

This system does not always work, as the local committeeman cannot always be depended upon to stick around the airport until the "straggler" checks in However, if regular scoring fails the pilot's word is taken. When a man is as much as 24 hours late an error of half an hour or so in his elapsed time makes very little difference anyway

Shop Notes and Technical Data

LOAD MEASUREMENTS ON AIRCRAFT TIRES

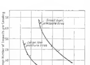
By Frank K. Starbird
Firestone Tire and Rubber Co

THE need for accurate information regarding the forces occurring incident to landing has long been appreciated and numerous attempts have been made to develop simple compact and reliable instruments which would give an accurate indication of such forces The Firestone Tire and Rubber Company engineers have designed such an instrument for use in their research work and it is described in this article

Observations of planes while landing indicate quite clearly that loads on the undercarriage and especially on the tires, are of a momentary nature and that the load fluctuates quite rapidly From a tire design standpoint, especially with large cross section low pressure tires it is highly important to know the maximum loads which are momentarily applied and the number of times the maximum loads occur The time interval between successive maximum forces is quite short as has been shown in the case of motor vehicles by means of a specially designed, curve drawing, carbon pile accelerometer using an oscillograph as a recording instrument. Actually this time interval is a function of the elastic properties of the suspension system and in the case of planes may vary considerably due to the properties of the particular shock absorbing system used

The only known practical method of determining momentary forces which occur between the tire and the ground is by measuring the acceleration and multiplying it by the weight of the parts which are accelerated and adding the weight of the load imposed upon the tire through the medium of the shock absorber It is therefore necessary to mount the instrument which measures the acceleration on the portion of the undercarriage which is accelerated by the interaction between the tire and the ground

After a few preliminary landing tests which were made on a reasonably level frozen landing field it was evident that the operation of the instruments used was satisfactory and that the sensitivity was such as to differentiate readily between several pounds difference in tire inflation pressure It is, of course impossible to control landing conditions. However, by observing such precautions as making successive landings as near as possible on the same place, conducting tests only on calm days, making ten successive landings and averaging the results it was found that surprisingly consistent data could be secured



Curves showing results obtained in tire tests

The accompanying graph shows typical results secured with a light training plane with two radically different types of tire equipment The number of shocks or impacts per average landing is plotted against the magnitude of the acceleration in ft. per sec per sec and it will be noted that there is a very outstanding difference in landing shocks between the two types of tire equipment used. The high pressure tire equipment not only shows a larger number of impacts per landing but the magnitude of the impacts is much greater than in the case of the low pressure tire.

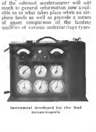
The importance of such information is well appreciated by those engineers who have had the problem of designing tire equipment and undercarriage equipment

The more general use of brakes has introduced a new factor of tire design as the additional weight appreciably increases momentary forces on the tire The exact amount of this increase for any specific set of conditions can be quickly and exactly determined by the use of the accelerometer

The accelerometer used in the present series of landing tests is a development of the Firestone Solenoid Accelerometer which was evolved after several years' research work and which has proved so effective in determining the magnitude and number of impacts which occur on various types of motor vehicles with different tire equipment The present instrument consists of six individual elements mounted in a case, which case is mounted at the point where it is desired to determine the number and magnitude of the accelerations which occur This case is connected by means of electric cables to a case which contains the counting instruments The entire instrument is operated from a storage battery Voltmeters ammeters and a rheostat are supplied by means of which the range of the various elements can be changed to fit the conditions of the particular test being conducted

Each element consists of a plunger mounted vertically within a solenoid At the upper end of the plunger is a contact which engages a similar contact mounted in a micrometer screw attached to the cover The electric current passing through the solenoid holds the contacts closed with a definite and predetermined force Acceleration along the axis of the solenoid tends to operate the contact and when the acceleration is equivalent to the pull of the solenoid, the contacts open The opening of the contacts causes a counter to operate, thus a number of elements and a number of accelerations supply information regarding the number and magnitude of the accelerations occurring

From tests conducted to date it is apparent that momentary forces or loads encountered during landing greatly exceed the load on the tire due to the weight of the plane when at rest, and that these momentary loads are influenced greatly by the type of tire equipment, shock absorber equipment and possibly by detail of the undercarriage Hence the more extended use of the solenoid accelerometer will add much to general information now available as to what takes place when an airplane lands as well as provide a means of exact comparison of the landing qualities of various undercarriage types



Instrument developed for tire load measurements

GOODYEAR-ZEPPELIN HANGAR DOORS

W. C. Raube
General Electric Co

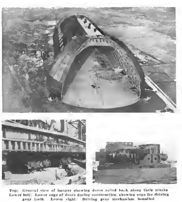
ONE of the many remarkable features of the Goodyear-Zeppelin Air ship Dock at Akron, Ohio, is the door operating mechanism. Buildings with similar doors of smaller size have been built in Germany, but this represents their first use in the United States.

In place of straight vertical doors moving in and out on a horizontal track, as in the case of most dirigible hangars the doors are of the "orange peel" type thus allowing them to be opened regardless of the direction of the prevailing winds at the time a ship is to be used. There are two doors at each end of the hangar. Each of the two doors are supported on a common vertical pin at the top. Wheels, running on tracks are mounted on the lower edge of these doors. The tracks upon which the doors are mounted extend down along the sides of the building, thus allowing the doors to fit closely along the sides of the dock, providing a full opening at the ends of the building.

The doors are operated by completely automatic push button control, each of the [illegible] 100 hp electric motors [illegible] with it for motive purposes. A [illegible] mounted hydraulic brake automatically slows down and stops the doors when they have reached the end of their travel.

To operate one of the doors in the forward direction, the button is pressed. This supplies current to the motor and the doors begin to open, soon attaining full speed. They continue operating at full speed until near the end of the travel at which time another switch is tripped. This operation inserts resistance in the motor circuit, slowing down the doors until the hydraulic brake is applied.

A complete motor control panel is provided from which one operator may control the entire mechanism. This greatly simplifies all the actions heretofore required in such a task at an airship dock.



Top: General view of hangar showing doors rolled back along their tracks. Lower left: Lower edge of doors during construction showing cogs for driving gear teeth. Lower right: Driving gear mechanism installed

LOCKHEED MONOCOQUE FUSELAGE CONSTRUCTION

By Charles F. McReynolds
Pacific Coast Editor of AVIATION

ALTHOUGH Lockheed monocoque fuselage construction has been described frequently in the past, the persistence with which this unusual type of construction holds forth warrants further review here.

The standard Lockheed fuselage is a plywood shell constructed in two halves and joined in a vertical plane passing through the center line of the fuselage. Manufacture of the half shell of the fuselage centers about the female concrete mold of the exact form of one half of the fuselage, and the male wooden form upon which the veneer strips are assembled. The shell consists essentially of three layers of spruce veneer, the inner and outer of which run longitudinally and are $\frac{3}{32}$ in. thick, while the center layer, which is $\frac{1}{16}$ in. thick, runs at right angles to the other two. The longitudinal strips are gore shaped, tapering from 1 in. wide at the ends to 6 in. at the center, and are cut to shape in bundles of about 30 at a time. They are assembled on the male form and are fastened together with gummed paper. The center layer is also assembled on the male form and is fastened to a spruce transfer ring which completely encircles the form. In assembling a fuselage the outer layer is placed in position in the concrete mold, held in place by strips of gummed paper tape along the edges of the mold and is then given a coating of casein glue. This, of course, is performed by several men to reduce the time of application of the glue which is mixed and applied at room temperature, no heat being used on the mold. A middle layer is given a coating of glue while it still rests on the male form. It is then turned over into the mold and coated with glue on the other side and the transfer ring removed, and the third layer placed in the mold with the side having gummed paper tape on it uppermost. The wooden lid to the mold is then lowered in place, carrying a heavy rubber bag of the exact form of the inside of the mold.

The lid is bolted down and the bag inflated to a pressure of about 20 lb. per sq. in. This condition of pressure is allowed to remain for approximately 8 hours after which the half shell is taken out and placed on the drying rack for removal of excess moisture. At this time all gummed paper tape used in the original assembly of the veneer strips is removed. The resultant half shell is a homogeneous piece of plywood without joints, cracks or laps, perfectly glued throughout and formed to the exact streamline shape required.

In assembling the complete fuselage two or three half shells are clamped into place on a skeleton framework held in a jig and consisting of fourteen elliptical laminated spruce rings held in place by four light spruce longerons, two of which are used to complete the top and bottom joints of the shell. Other longitudinal brace members are incorporated into the skeleton at the points where cutouts are to be made in the shell for doors, windows or cockpits.

It is possible to mount all fuselage fittings to the wings or diaphragms before the shell is fastened in place, thus simplifying this work. No members of any sort are fastened directly to the shell, all loads being distributed through the diaphragms. In these diaphragms, which vary in cross section from 3 in. square where the heaviest loads are applied to about $\frac{1}{2}$ in. square near the tail of the fulelage, there are four main rings. Two carry a wing spar load, one the engine mount load and the fourth the tail skid mounting. Extra reinforcement is provided at each wing beam diaphragm and the tail skid diaphragm and consists of an added thickness of plywood of the same thickness as the $\frac{3}{32}$ in. shell, 10 in. wide and extending completely around the fuselage between the ring and the shell. The size of the completed fuselage varies from a maximum depth of 60 in. and width of 48 in. to a depth of 48 in. and a width of 36 in. at the nose mount attachment, a depth of 18 in. and a width of 12 in. at the rear tip. The two half shells are nailed and glued to the fuselage scale framework, after which the exterior of the completed shell is coated with glue and a covering of airplane fabric is stretched smoothly in place over the entire structure. The interior of the completed fuselage is protected by Lionoil, while the exterior is sprayed with primer and lacquer enamel to a high gloss finish. In the construction of the "Sirius" an incision is made on the under side conforming to the wing curve at the center section so that the wing may be set into the fuselage. Other incisions are provided on the upper side for the two cockpits and baggage compartment door, and two slits are cut at the rear to accommodate the horizontal stabilizer which passes completely through the fuselage. Minor reinforcement along the edge of each cutout is accomplished by glueing and nailing plywood strips in place, while major reinforcing consists of longitudinal wood blocks between diaphragms with steel tie rods running from the front to the rear of each cutout in order to bind the reinforcing blocks firmly into the structure.

The wing is fastened to the fuselage by means of sixteen nickel steel bolts passing through eight steel fittings, four on the spars and four on the corresponding diaphragms. While these fittings are aluminum alloy castings in the Vega model, the Sirius employs oxy-acetylene welded fittings of normalized chrome molybdenum steel having a tensile strength of 95,000 lb. per sq. in. These fittings also support the landing gear.

In repairing a damaged Lockheed fuselage a plywood section between diaphragms is removed and replaced by a similar section cut from a corresponding part of a spar shell kept in stock at the factory. The splice is made carefully and the replacement piece always has the same curve as the original.

CONSTANT SPEED WIND TUNNEL CONTROL

By E. L. Judkins
General Electric Co

IN ORDER to predict accurately the behavior of a plane in flight from wind tunnel tests, it is not only necessary that the air velocity or blower speed be held constant while taking any set of readings, but that it be adjustable over a range corresponding to the operating speed of the plane.

For this purpose the General Electric Company has designed regulators which when used in conjunction with a suitable motor generator set and blower motor, will automatically hold any desired speed very accurately. The speed of the blower motor and hence the air velocity may be varied over a wide range as high as 10 to 1 or even more by using a suitable pilot generator. The equipment is also laid out so that it can be thrown over to hand control at any time.

One of these speed regulator equipments, now installed at the California Institute of Technology, is said to hold the instantaneous speed changes to less than a plus or minus 0.2 per cent after the regulating equipment has assumed operating temperature, requiring about half an hour.

With the regulator in service the speed of the blower motor may be changed by simply turning in or out the speed adjusting rheostat in the armature circuit of the pilot generator. The equipment will automatically adjust itself to hold the new speed corresponding to the new setting of the rheostat.

The equipment consists essentially of a synchronous motor direct connected to a direct-current generator of suitable capacity for driving the direct-current blower motor. The synchronous motor generator set has two direct-connected exciters. One exciter operates at constant voltage and the other at variable voltage. The constant-voltage exciter is used to excite the synchronous motor, the variable-voltage exciter, the blower motor, and the pilot generator, the latter being direct connected to the blower motor. The variable voltage exciter furnishes excitation for the main generator.

The speed of the blower motor may also be controlled manually by cutting out the regulator. In this case the speed is varied by means of a motor-operated rheostat in the field of the main generator, from a push-button station. In order to raise the speed when the regulator is in operation, it is only necessary to increase the resistance in the armature circuit of the pilot generator and to lower the speed to decrease the resistance.

SANITARY PLUMBING FOR AIRCRAFT

By John F. Hardecker
Naval Aircraft Factory
Philadelphia, Pa

THE evolution of the interior of the modern passenger carrying sport and transport plane has been one of the outstanding phases of current aeronautical development. Passenger chairs, the decorative treatment of walls and ceilings, aircraft hardware and lighting fixtures, each in turn have been the highlights of this development. In the race, first one and then the other would gain a momentary development far in advance of its contemporaries, until they each have attained a coordinated development that leaves little to be desired, except for the normal advance that is an inseparable attribute of an active industry.

This has, however, not been true in the past with respect to the sanitary equipment of the planes. The need for sanitary equipment in airplanes has been met in a fashion, but in a way that in-

troduced excess weight, was wasteful of space, and decidedly crude and inartistic in appearance The installation invariably consisted of an unrelated combination of independent units, each merely a utility part, designed and manufactured without any very great consideration of the attractiveness or effectiveness of the assembled installation. The problem of proper sanitation is admittedly a very complicated one, and while a great deal of academic interest was spasmodically registered in it by various specialized sanitary equipment organizations no really expert experience was brought to bear consistently on the problem Too often the solution was too highly influenced by the dictates of the plane designer who was clearly out of his natural field when it came to sanitary installations

Yet the general traveling public has a right to expect the same degree of convenience and beauty of sanitary facilities in airplanes that it now has in Pullman cars and the plane manufacturer has long recognized the necessity of satisfying this right if he is to successfully compete for business with older established means of transportation

It therefore seems to be perfectly logical that the problem should be best solved by applying to it the knowledge and experience gained in meeting similar problems with the other forms of transportation namely railroads, buses and boats

The Imperial cabin toilet manufactured by the Imperial Brass Mfg Co of Bridgeport Conn and illustrated in this article, is a self contained unit designed from three different standpoints —minimum weight, minimum space and artistic design It is patterned after the lavatory toilet chair combination used in the recently introduced bed room cars of the Pullman Company

There are three outstanding advantages to this unit. It is complete within itself, combining water and liquid soap storage, lavatory and water flush toilet in a compact article that can be moved and placed in any desired location Second, it occupies only a part of the space used now by the conventional type of corner bowl and open toilet It is possible to use two of these units in the same space now occupied by the one toilet room in the 12 to 14 passenger plane Third it is equipped with the Pullman type flapper valve and is water sealed against all odors The Toilette is a water flush type, perfectly sanitary in all respects

The practical advantages of this unit are supplemented by the decorative effects possible Its pleasing appearance allows the use of the toilet room as a dressing room without the feeling of distaste that would ordinarily prevail. The modernistic design as a whole is carried into detail in the shape of the Venetian mirror, side lights and toilet seat The back of the chair (which forms the bottom of the lavatory) is upholstered in rich velour or leather, and the color scheme is followed in the finish of the toilet seat, frame and covering of the unit A variety of colors are provided to harmonize with the interior decoration of the planes The panels may be had of perforated metal, solid sheet in tile or painted finish or of special sheet materials

The water tank, although mounted is not integral with the frame It can be replaced with a tank of different capacity and shape or it can be placed in a remote location where a much larger capacity may be stored and from there piped to the toilet proper The unit is so made that where hot and cold water are required, special faucets may be provided

The folding lavatory bowl is elliptical in shape, and so designed that one pint of water gives a sufficient amount for ordinary washing The lavatory is made of aluminum, highly nickel plated. This insures against stain from the soap and water and makes it easily cleaned and attractive in appearance.

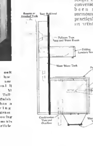
After washing, the lavatory swings into a vertical position and dumps the waste water into the receptacle From here the water flows around the rim of the nickel plated funnel shaped ring At the bottom of the funnel and attached to it is a specially designed flapper valve A limited amount of the flushing water remains in the valve and forms a water seal. The winged lever operates this flapper valve, similar to that in the Pullman toilets The highly nickel plated finish on both the flapper valve and funnel makes for perfect sanitation and cleanliness.

The elimination of the waste material presents a difficult problem in the airplane due to the limited capacity of containers and the sanitary objection to ejecting into the air Two methods are now commonly used

The first of these is the conventional solid bottom bucket type, but with a combined vent and overflow which withdraws odors and excess water This arrangement requires removal at the end of each trip and is easily accomplished by removing two spring clip locking clamps and disconnecting the water flush inlet hose

The second is a new development eliminating many objectional features of the bucket It consists of a container tapered through the bottom of the plane and sealed by a spring clip dump valve This arrangement allows the dumping of the waste material at the end of the trip into a suitable container without entering the plane

To attempt to evaluate the significance of this development in the aeronautical field is to predict the obvious One of the outstanding obstacles to passenger comfort and convenience has been successfully surmounted, in a practical as well as an artistic manner



Above Toilette unit with wash bowl lowered ready for use To empty the bowl it is folded back At left The closed Toilette, in plain finish The upper one has a wicker covering Right A diagrammatic sketch showing the various elements described in the article

New Equipment

TRI-ENGINED OGDEN "OSPREY"

MANUFACTURED by the Ogden Aeronautical Corp, the "Osprey" is powered with three American Cirrus, 95 hp, engines This plane has recently been granted Approved Type Certificate No 332 and has been given many test flights around the country—the most recent of which is that of the Cirrus air tour The "Osprey" is a high wing, externally braced monoplane with a wing span of 50 ft, a length of 34 ft 6 in., and a height of 9 ft 3 in The plane seats six people

In construction the "Osprey" follows conventional practice the fuselage being built up of welded chrome molybdenum steel tubing and the wings of wood the entire plane being fabric covered The wings are built in three parts a center section extending out as far as each outboard nacelle and two outer panels. Spars are of spruce and plywood, box beam type with spruce ribs mounted on them Compression members are of tubular steel with single drag wire bracing between spars Ailerons run the full length of the outer wing panels except for tip shielding at the outer end and are carried in three Zerk lubricated bearings The Gottingen 398 section is used for the wing

All engines are carried in permanent steel tube mounts the auto hood type of cowling making them easy to work on Exhaust of the center engine is directed to a point beneath the cabin, while each outboard engine exhausts through a bayonet silencer inside the nacelle cowling This feature adds to the appearance of the plane and materially reduces engine noise An aluminum fire wall lined with corrugated asbestos, is placed in the rear of the nose engine and serves to insulate the cabin against noise carried back from the center power plant All engines are provided with Eclipse hand starters Propellers are of wood, manufactured by the Story Gawley Propeller Company

Two doors at the rear one on each side, provide access to the plane, the left door being used normally and the right being available for emergencies A lavatory compartment is provided in rear of the cabin, and a large baggage space is reached from within the cabin Shatterproof glass is used for all windows, those on each side of the pilots being easily raised or lowered for visibility or ventilation The entire cabin is lined on the inside with Insulite sheeting while a 1½ in. blanket of Dry Zero is placed between this and the fabric fuselage covering in order to minimize noise and temperature changes The interior of the cabin is attractively finished in fabric with polished wood moldings and a dome light in the ceiling The floor is thickly carpeted while the six chairs of steel tube framework comfortably upholstered, are carried in sockets mounted directly on the fuselage framework, which is specially braced to carry the air loads and to insure their remaining in place even in a severe crash

Dual controls are provided at the front two seats by means of a conventional swing over wheel column and individual rudder pedals of the swing type All control surfaces are operated by cables running over pulleys to horns The Bendix wheel brakes are controlled by means of a hand lever which may be set to any desired tension and by simply working the rudder pedals this tension is transmitted proportionately to both wheels

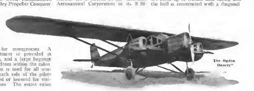
Specifications as furnished by the manufacturer are given below

Length overall	34 ft 6 in
Height overall	9 ft 3 in
Wing span	50 ft.
Wing chord	7 ft
Airfoil section	Gottingen 398
Total wing area	312 sq ft.
Aileron area	26 sq ft
Stabilizer area	23½ sq ft
Elevator area	17½ sq ft
Fin area	9 sq ft
Rudder area	9½ sq ft
Weight of plane empty	2800 lb
Pay load	950 lb
Disposable load	1700 lb
Gross weight fully loaded	4500 lb
Power plant	3 Am. Cirrus air cooled
Power plant h p (each engine)	95 at 2100 r p m.
Wing loading	14 4 lb per sq ft
Power loading	15 8 lb per h p.
Propellers (3)	Story-Gawley wood
Landing gear tread	14 ft

The American Savoia S 56

THE SAVOIA S-56 LIGHT AMPHIBION

A LIGHT amphibion which is adaptable for both private and commercial use is offered by the American Aeronautical Corporation in its S 56 This plane follows the conventional Savoia-Marchetti design Its spars and ribs are of wood and the wings, stabilizer and ailerons are fabric covered The rudder is constructed of sheet steel and aluminum alloy and the fin is built up of wood and duralumin The elevators are made up of welded steel tubing and the hull is constructed with a diagonal



The Ogden Osprey

double planked bottom and covered completely with plywood and fabric

A Kinner K-5 engine is used with a Paragon propeller Two fuel tanks with a total capacity of 28 gal are in the hull and wings respectively

The retractable landing gear is of the jack-knife type and is cable operated from the cockpit The shock unit is rubber cord which may easily be replaced. The gear uses wire wheels of 20x4 size and has a tread of over 5 ft Two people sit in an open cockpit slightly to the rear of the engine, and space is provided for a third passenger immediately in the rear of this

The conventional instruments and controls are installed as standard equipment. Starter is optional The stock plane is painted silver at all points above the water line, all those below being painted black

The plane has a length of 25 ft 2 in, a span in the upper wing of 34 ft 2 in., and a height of 10 ft 1 in It has a wing area of 286 sq ft The weights are listed as 1,447 lb empty, 342½ lb pay load, 170 lb for pilot and a total gross weight of 2 150 lb

THE MACCLATCHIE "PANTHER" RADIAL

APPROVED type certificate number 349 has been issued by the Department of Commerce on the MacClatchie "Panther" seven-cylinder, air cooled "L"-head radial engine which is rated 150 hp at 1900 r.p.m. The engine weighs 400 lb dry and has an overall diameter of 36 in

The "Panther" radial has been developed over a period of two years by the engineering department of the MacClatchie Manufacturing Co manufacturers of oil tool specialties, Compton, Calif In developing the L-head radial it is claimed that many parts have been eliminated, lubrication problems simplified, and air resistance greatly lessened due to decreased overall diameter. Cooling problems have been solved by placing the exhaust ports at the front of the cylinder head and by designing the head for circulation of air completely around each valve seat and port

The "Panther" radial

The crankcase of the "Panther" engine is built in four sections of aluminum alloy The nose section carries the propeller thrust bearing and houses the cam and cam drive gears The cylinders are mounted on the two center sections which join along the center line of the cylinders. And the rear section carries all accessories, starter and induction manifold.

The cylinder barrels are of chrome nickel steel with integral fins machined from the blank forging Heads are of heat treated cast aluminum alloy screwed and shrunk on the barrels One intake and one exhaust valve is carried in each head and these seat on inserts of aluminum bronze The cylinder heads incorporate an improved type of turbulent combustion chamber, with two spark plugs mounted opposite each other It is possible to grind valves without removing the cylinders, merely unscrewing the port plugs over the valves

The drum type cam is machined from nitralloy steel, is of single track design with four lobes and turns in the same direction as the crankshaft at one-eighth crankshaft speed It is mounted on a double row of ball bearings on the crankshaft itself All valve stems contact the cam track direct and are lubricated by spray from the crankcase

The crankshaft is of two-piece construction, the crankpin being integral with the front section The shaft is of heat treated nitralloy steel The rear section of the crankpin telescopes through the hollow front section of the pin and locks in place with a nut

The counter-weights are pressed in and fastened by permanent lugs and bolts Of chrome-nickel steel, the connecting rod assembly includes a babbitted I-section, one-piece master rod and six tubular link rods attached to the master rod by knuckle pins. The Vitalite alloy pistons are ribbed for lightness and cooling Each carries three compression rings above the wrist pin and an oil ring below The full floating wrist pins are machined from alloy steel and are held in place by steel spring locks

Ignition is supplied by two Scintilla magnetos Stromberg carburetors, type NAR5A, are standard equipment, and are installed at the rear of the engine with the intake mixture being induced through a star-shaped manifold with a central distributing cone An oil jacket around the intake manifold assists in vaporizing the fuel mixture as well as cooling the hot oil from the engine

Pressure lubrication is used to all main bearings of the engine, the scavenger pump having a capacity double that of the pressure pump in order to insure a clean crankcase at all times Oil flows from the tank through the pressure pump to a collector ring at the rear of the crankshaft and thence through the shaft to the main bearings, master rod bearing, and the sump The pistons, link pins, gears and bushings are all lubricated by spray from the master rod, and the cam and thrust bearings are lubricated by spray from the middle section of the crankcase. The main shaft bearings are of roller type, the thrust bearings are of ball type and all other bearings in the engine are of plain bronze or babbitt design

The specifications of the MacClatchie "Panther" are as follows

Rating	150 hp. at 1 900 r.p.m.
Bore	4½ in.
Stroke	5⅛ in.
Displacement	812 15 cu.in
Compression Ratio	5 to 1
Carburetor	Stromberg NAR5A
Overall diameter	36 in
Length	38 in.
Weight (dry)	400 lb

MENASCO "PIRATE" INVERTED ENGINE

PRODUCTION is now under way on the Menasco "Pirate" B-4 aircraft engine which was issued ATC No 50 on May 10, 1930, with a rating of 90 hp at 1925 r.p.m The factory of Menasco Motors, Inc., Los Angeles, Calif., has been completely equipped with special machinery, and precision jigs, tools, and dies, for full quantity production on the 90 hp model, and also for early production on the new six-cylinder engine, now undergoing flight tests, which will have 90 per cent of its parts interchangeable with those of the smaller model

The "Pirate" in-line engine

Developed under the direction of A S Menasco, the "Pirate" has been engineered with the collaboration of various aircraft engineers and designers. The engine has been under development for more than two years, and is of conventional inverted, in-line type. Although the rated hp is 90 at 1925 r.p.m., the engine will develop 100 hp at 2100 r.p.m and has been operated at speeds in excess of 2400 r.p.m. The "Pirate" has four cylinders in line, with bore of 4½ in, stroke of 5⅛ in, and total piston displacement of 326 cu in, the compression ratio being 5.5 to 1 Overall length of the engine is 47⅞ in., overall height 28½ in, width between mounting pads 11¾ in, and weight without hub or starter, 280 lb

There are but four gears in the entire power plant Angularity of push rods is small and the entire valve mechanism is efficiently lubricated by gravity flow All

accessories are mounted on a single case at the rear of the engine. The complete cylinder and cylinder head is removable by loosening four nuts Pressure oiling of all parts of the engine has been perfected Valve mechanism troubles have been reduced by using rollers, ball bearings and ball socket joints at respective wearing points All external parts of the engine which are subject to rusting have been protected by Parkerizing or Cadmium plating Care has been taken with all final details such as wiring, conduits, rubber wiring shield, complete tool kit for engine maintenance, etc

The crankcase is built in three sections of heat treated aluminum alloy The upper case is light but well ribbed and acts chiefly as a cover, incorporating the breather caps and handling lugs All gear driven accessories are mounted on the rear case. Both magnetos drive directly from the gear on the rear end of the crankshaft with the cam driven from the right magneto gear

The vertical shaft which drives the oil pump continues to the bottom of the crankcase for fuel pump drive, a standard S.A E fuel pump mounting being provided Weight of the main case is 40 lb and of the upper cover, 10 lb Four detachable legs, dowelled and bolted to the main case carry the weight of the power plant to the engine mount bearers

Connecting rods, machined from Lynite forgings, are of "I" beam design with ample fillets A one in nitrided steel piston pin operates directly against the aluminum alloy of the connecting rod.

Two 1¾ in valves are set vertically in each cylinder, the rocker arms being fore and aft mounted Combustion chambers are of flat head truncated wedge type, with inlet and exhaust ports at diametrically opposite sides of the cylinder heads Exhaust manifolding is optional either by conventional manifolding or individual cast aluminum and heavily finned stacks Intake manifolding combines an updraft carburetor, Stromberg 1½ in., with a downdraft manifold, which is oil jacketed for equalization of oil temperatures and intake mixture

All oil leads are of steel tubing cast into the case The only external lines are those which connect with the oil tank The pump is so mounted that air locks are impossible and overnight drainage of oil cannot prevent oil surrounding the pump itself at all times Pressure is maintained to all main and connecting rod bearings, while piston pins and cylinder walls are lubricated by splash, and cam shaft bearings by gravity cups fed by splash Gears and bearings in the accessory case are also lubricated by splash from the main case Oil is carried through the hollow crankshaft by drilled leads and an ingenious hollow dural spool device pressed into the opening in the shaft at each crankpin and main journal which permits oil to flow freely through a $\frac{1}{16}$ in annular space between the walls of the spool and the 1¼ in. hole drilled in the shaft Provision has been made for the installation of an oil sump thermocouple and an oil pressure gauge connection, if desired

Ignition is supplied by two Scintilla magnetos flange mounted. Bosses are provided on the front of the crankcase for mounting of engine cowling, and on the side of the case for mounting a side air scoop

Officials of the Menasco Motors Inc., are Albert S Menasco, pres, W. K Jay, vice pres, Clyde W Holley, secy and treas, John Weisel, chief engineer, Mott Haines factory sup't; Wm Hogarth machine shop sup't., and R W Wenger chief inspector

Specifications of the Menasco "Pirate" determined by tests and furnished by the manufacturer are as follows

Bore	4½ in.
Stroke	5⅛ in
Displacement	326 cu in
Compression ratio	5 5 to 1
Rated power	90 hp at 1925 r.p.m
Maximum power	100 hp at 2100 r.p.m
Fuel consumption	55 lb per B.H.P per hr
Oil consumption	010 lb per B.H.P per hr
Total weight, without hub or starter	280 lb
Ignition	Dual Scintilla
Carburetion	Stromberg Type NA-R5
Spark plugs	Champion Aero 'A'
Length overall	47⅞ in
Height overall	28½ in
Width between mounting stubs	11¾ in

The Salesman's Notebook

THE HANGAR AS A SALESROOM

By H. C. Lippiatt

Travel Air Distributor For Southern California

DURING a year and a half of airplane selling at the Los Angeles Metropolitan Airport, Van Nuys, Calif, we have found that the hanger, if properly utilized, is an ideal salesroom Our hanger is of modern steel construction with a smooth concrete floor It is cool in summer, warm in winter, free from dust and is quiet at all times

We take care to see that the hangar is kept bright and clean and see to it that engines and planes are wiped free of oil and dust With everything clean we are free to invite the wealthy business man or sportsman, who probably does not want to soil his clothes no matter what he may be wearing at the moment, to browse around in our hangar with us and look over the various models at his leisure

Although it is sometimes necessary to crowd the planes in at night, each morning we place all surplus or visiting planes out on the line and arrange our regular stock of planes so that there is ample room to walk around on all sides of any of them without ducking under a wing or dodging struts or wires.

We find that the cleanliness and quiet of the hanger, coupled with ample room to move around and inspect all planes and the fact that the various models are all close together for easy comparison of their respective features, puts the prospect in a receptive mood Our sales talks are less difficult because of the hanger "atmosphere"

If the prospect proves to be a "live one" and requests that a certain plane be demonstrated to him, we are always ready to go Not only are the planes kept spick and span in appearance, but they are maintained in top notch shape mechanically and are always serviced with fuel and oil. Within five minutes after the request for a demonstration the plane is out on the line warming up Because of the hangar display approach we find that the demonstration is more effective. We feel that many of our sales can be directly credited to giving the prospect an opportunity to first get acquainted with the airplane in an undisturbed atmosphere free from the distractions of the flying field

SELL THEM WITH MOVIE TALKS

By James Allen Clyde

ENTERTAINING prospects of various types with lectures on phases of aeronautics and aeronautical activity has been found to be extremely profitable by the Chicago branch of Curtiss Wright

Contributions to this department are solicited, and as an inducement to aeronautical merchandising men AVIATION will pay the sum of $20 for the best article, $10 for the second best, and $5 for every other article printed. Merchandising value, originality and brevity will constitute the judging yardstick. Contributions must be in this office by the fifth of the month for insertion in the following month's issue.

Flying Service, Inc. These talks are given about once in three months under the supervision of the sales department at the headquarters of the branch 1338 South Michigan Ave.

Recently some 250 prospective students for the Curtiss ground school were entertained at a showing of motion pictures of both the 1928 National Air Races taken at Los Angeles, and the 1929 races, which were held at Cleveland. F. K. Colglazer, comptroller of the air race organization, talked on the races while the films were being shown. Those in attendance came in response to formal invitations sent out by the Curtiss Wright sales organization.

Since the showing of the films 37 of the 250 that attended the exhibition are reported to have signed up for the general ground school course offered by Curtiss-Wright.

A SALE AND A JOB

By J. B. Alexander

Fairchild Salesmanager for Southern California Territory

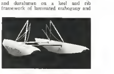
WHEN selling to men who are not particularly familiar with aircraft too much importance cannot be attached to the desirability of having the right man at the controls when it comes time for a demonstration flight. This is especially true when these men (who may be wealthy individuals buying a plane for sport and pleasure, or who may represent a business house investing for commercial reasons) have no intention of learing to fly, but plan on hiring a competent pilot to operate the plane. In such a case the plane no matter how excellent, is no better than the pilot who eventually takes over the job of flying it.

When confronted with such a prospect we endeavor to bring the would be purchaser in touch with the man who, in our opinion, will be an ideal pilot for the job. By keeping closely in touch with all the pilots in our part of the country we are able to recommend certain men with every confidence that they will see to it that the plane we sell is given a fair chance to prove its worth in actual service. We arrange for our prospect and his prospective pilot to meet before any flying demonstration has been made and then have our demonstration made by the pilot who wants the job of flying the air plane. In that way we have the pilot working for us because he is trying to land the pilot job. He demonstrates the plane and his own ability at the same time and if he can sell himself to the owner-to-be of the plane everyone is happy for its almost a cinch that we'll get the prospect's check for the airplane.

We have followed this plan with great success in a number of cases and feel that it is applicable to a great many sales of the higher priced planes which are going to be used for the transportation of executives, or wealthy sportsmen and will ultimately be quoted in heavy brass, steel and nickel alloy as well — AVIATION *October, 1930*

Pontoons

PONTOONS in three standard sizes are in production by the Aircraft Products Corp, 7424 Melville Avenue, Detroit. The hulls are built of alclad and duralumin on a keel and rib framework of laminated mahogany and



Aircraft Products Corp pontoons

airplane spruce. Multiple watertight compartments are provided in each pontoon with the bulkheads adding to the strength of the structure. All parts are bolted together for ease in repair and maintenance in the field. Pontoons are streamlined fore and aft — AVIATION, *October 1930*

S K F Ball Bearing

A FELT SEAL ball bearing has recently been developed and patented by S K F Industries, Inc., 40 East 34th Street, New York City, and is available in sizes applicable to a wide range of small mechanical equipment. The felt seal, provided as an integral part of the bearing, makes it necessary for the machine manufacturer to provide only one housing enclosure.

The outer and inner races, as well as the balls, are made of high carbon chrome alloy steel hardened throughout. Bore and outside diameter are ground to international standard dimensions and tolerances, and the width is slightly greater than the standard dimension of a single row bearing, in order to accommodate the felt seal. The ease with which the seal may be disassembled and new felts applied is an outstanding feature of the design, according to the manufacturer — AVIATION, *October, 1930*

The Buyers' Log Book

Altimeter

A WEATHER watch barometer usable as an altimeter, has been perfected by the Commercial Instrument Co., this city. On the rising side of the barometer the readings are "windy, fair, and change," while on the falling side it is marked "dry, rain, and storm." Models of this instrument are now available and production was started September 15. — AVIATION *October, 1930*

Aerochrome Valve

A NEW type of heat resisting valve especially applicable to aircraft engines has been introduced by the Aerochrome Engine Valve Co., Ltd., Oakland Calif., successors to the Mackay-Austin Valve Co. This is known as the Aerochrome Hi-Heat valve and is manufactured under the patented "Harris Process." Valves are made in all standard sizes. It is claimed that the Aerochrome valves will not burn or warp corrode or scale, or become brittle under normal operating temperatures of air cooled engines, and that they resist carbonization, will not stretch, and are exceedingly strong at high temperatures —AVIATION *October 1930*

New Parker Coupling

TRIPLE tube couplings have been designed and are now in production by Parker Appliance Co, Cleveland Ohio to meet installation conditions where entering the tube into the coupling body is inconvenient. The new product does not displace the standard tube couplings, but may be used in conjunction with them. Triple couplings are now being furnished in standard weight brass or duralumin

New Catalogs

▶ *J-M Flooring*. Of interest to aviation is the manual, "Reducing the Weight of Car Flooring" lately published by Johns Manville This takes up combinations of truss plate and Mastic coke for car flooring, comparing truss

plate with other types of fire proof floors. Decorative possibilities are illustrated.

▶*Keystone Planes*. A new publication of Keystone Aircraft Corp. relates briefly the growth of the organization and gives general descriptions of the Patrician, Air Yacht and Commuter, with specifications. The illustrations in the booklet include views of the plant at Bristol and interiors of the planes.

▶ *J-M Power Plant Materials*. A new 64-page manual is available devoted to applications of Johns Manville materials in the power plant, insulating materials, and other building and construction materials. Many of these applications are illustrated by diagrams and tables.

New Volumes for the Shelves

A RESEARCH DIRECTORY

FIVE YEARS OF RESEARCH IN INDUSTRY, *a reading list, compiled by Clarence J. West, National Research Council, New York City, 91 pp., 50c*

WHILE there may be some in the aviation industry who are interested in a more or less general view of research progress made during the last five years in all types of industry, it is doubtful if the entire contents of this volume will be used and appreciated by everyone into whose hands it falls. However, for those interested in aeronautics alone, the book provides a fairly complete list of papers and articles published during the last few years, dealing with research in that subject.

Mr. West has diligently searched through the technical and scientific mediums, of this country and abroad, and placed down each of the articles which should be of interest to anyone in aeronautical research work. The one objection to this list is that, for a book of its type, it is not sufficiently complete.

The average aeronautical engineer will at one time or another find one use for the other topics in this manual. Factory work, metallurgy, chemistry and many other headings are found there — HENRY O. PATTISON, *Assistant Editor*, AVIATION

AVIATION AND THE GUGGENHEIM FUND

THE SEVEN SKIES, *By Harry F. Guggenheim, G. P. Putnam's Sons, New York, 216 pages, $2.50*

OSTENSIBLY a general historical sketch of aviation, this book is in reality an exposition of the part the Guggenheim Fund for the Promotion of Aeronautics played in aviation affairs from the time of its founding in 1926 to its dissolution the first of this year. Mr. Guggenheim headed this organization throughout its career and left it to become the Ambassador to Cuba, whereupon the Fund was discontinued.

The Fund did play an important part in American aviation during the rather exciting years of its life and any broad treatment of aviation of that period would be incomplete without describing the Fund's influence. It is to be regretted that the book was not devoted definitely to a record of the Fund's activities setting forth the wealth of detail which must be available.

The book sketches the Fund's connection with such events as Lindbergh's national tour, the safe aircraft competition, the model airway experiment between Los Angeles and San Francisco, the fog flying laboratory at Mitchel Field, roof-marking, etc. All of these were outstanding contributions to progress.

The book is interesting and the information is worth having in summarized form. In general it whets the appetite for additional reports about the same events, however, and one cannot help wishing that the book had been confined to the field occupied by the Fund and a more complete report of its career —CHARLES H. GALE, *Assistant Editor of* AVIATION.

Abstracts and Reviews

SLOT TESTS ON A MOTH

STALLED FLIGHT TESTS OF A MOTH FITTED WITH AUTO CONTROL SLOTS AND INTERCEPTORS, *By E. T. Jones, Flt.-Lt. C. E. Maitland, and Flt.-Lt. W. E. Purdin, British Aeronautical Research Committee R. & M. No. 1292*

AT the invitation of Messrs. Handley Page, Ltd., the writers of this report, all connected with the Royal Aircraft Establishment, made test flights of the DeHavilland Moth, G-EBXG, a standard Cirrus II Moth except for the auto control slots and "interceptors" fitted to the upper wing.

The span of the slats was 33% of the wing semi-span. The "interceptors" consisted of a flat plate, 2¼ inches wide and of span 75% of the slat span, hinged along its longer edge on the upper surface of the upper wing 4 inches back from the leading edge. It lay under the slat when the slot was closed, and behind the slat when open. It was geared to the aileron control in such a manner that the port interceptor rotated about its hinge as the port aileron was rotated from 10° up to its full-up position, and the starboard interceptor was similarly rotated by upward rotation of the starboard aileron. When either aileron was at its point of maximum upward rotation the interceptor was normal to the upper surface of the wing at the line of rotation. Within the range of port aileron up to 10° to starboard aileron up 10° both interceptors were lying flat between the slat and the upper surface of the wing when the slat was closed on the wing.

The purpose of the arrangement was to set up a yawing moment by means of the interceptor which would counterbalance the adverse yawing moment which tends to yaw an airplane in the direction of the downward aileron when the airplane is in a stalled attitude.

In the tests, the airplane was stalled and the control column put hard over. Response was immediate. With rudder held fixed the machine could be rolled from side to side with precision and without reverse yaw. Full port rudder was applied and the aircraft rolled about 45° after which it was returned to level flight by means of the starboard ailerons, the rudder remaining hard over. With starboard rudder, the port aileron control brought the machine to a level keel, but it continued yawing slowly to starboard. In spins, both the left and right, a decided slowing up in the rate of rotation was observed when the stick was put hard over, but the lateral control was not sufficient to bring the ship out of the spin against the rudder. This action was accredited to the interceptors alone, since it had been observed previously that crossing the standard differential ailerons against the rudder had no effect on the spin. The lateral stability at the stall was good and the lateral control was improved in high speed flight as well as in the stalled condition. It was concluded that the use of interceptors was advantageous, and worthy of further development.

Side Slips

BY ROBERT R. OSBORN

THE CHICAGO AIR RACES

Report of Side Slips Special Correspondent (With appropriate apologies to Mr Ring Lardner)

DEAR EDITOR Well, Sir, I has been out to the so called Nat Air Races an regret to announce I dident enjoy them so much in spite the fact that it was the best managed air race in history My complaints is only the races is strung out too long an spread too thin Each year the races seems to take longer an longer, in days that is, not in speed around the course, but as they is beginning to make a profit on them maybe that is the reason At any rates I beg to state that this was the best managed show they has been yet an the birds what run it deserves the greatest of credits A course a lot of good men put it over but I think R W Schroeder who I has jokingly nicknamed "Shorty" on account him being so tall an Cliff Henderson had as much to do with this as anybody Shorty had a telephone booth on top the stand where he could reach out an tag the racers as they went by, an he must of slept up there as nobody ever seen him anywhere else Anyways he an Cliff was always using three 'phones to once an seemed to be running all Cook County besides the air races an maybe directing the Long Island Polo matches at the same time To be sure some scoffers will say they can always get the crowd out when they hear I an Lindbergh an Doolittle an Williams will be there but the proofs of the good managements was the show went on nearly as well when I and Lindbergh got tired an went home

As usual the stunting made the big hit with the crowd an it was darn good Al Williams an James R Doolittle put on their smooth show an besides had stunt boys with them from all countries They was all good but for hair raising this Frenchman Doret took the prize an for good clean fun a young fellow name Atcherley from England sure put on the show. Aside from spending most of the time in the air on his back this Atcherley had a act he called "crazy flying" which title didn't draw no complaints from nobody He done all the things solo students done in Jennies for years all in one flight but made the ending different by bringing the ship back whole It sure brought tears to the eyes of the old timers to recall the days when they was running around the solo field trying to keep out of the way of their students on the first landing The Army Navy and Marines put on their high class show too, although not so much of it as previous shows Maybe that was just spread out thinner too At any rates what they was, was first rate an everybody agrees the services hors is grade A peelos

During one of the early days Casey Jones added a nick on his control stick by stepping out an winning another race Casey has been winning races so many years the grandstand seemed surprised he didn't have long white whiskers and didn't need to be helped in the ship At first there was some comment Casey must have had a double on account him being a aviation executive now an everybody knows executives don't fly, but Casey couldn't have no double so it must a been himself in person, an not a motion picture

They was one of the funniest things happen in the Press Box when C B (Is Zat So?) Allen steps out an wins the Sportsman Pilots Race C. B is Aviation Ed. of the N Y *World* but a course "Deak" Lyman of the N Y *Times* offers him a large sum for the exclusive story C B dident pay no attention but went on autographing baseballs for the rest of the boys in the Press Box Deak even offered him a million dollars an showed him how nice it would look in print 'How I Win Sportsman Pilot Races C B Allen's Own Story All Rights Reserved Including Lands Discovered' but C B was busy heating up a timer what claimed he had cut all pylons an probably had a couple of illegal outboard engines hid on board too Finally after C B had turned down a million an a half Deak offered him all he had with him in cash one dollar an thirty seven cents and they rushed over to the telegrapher but the story had already went to the World. So C B beat up the operator an sold the exclusive picture rights for the thirty cents

Also prominent was a young fellow name Ben Howard what lifted the morgage on the old homestead with a home made airplane he built outen some sheets barrel staves an a Gypsy engine This ship was entered in everything but the amphibian rescue contest an anytime of the night or day this ship would be out there rounding the pylons His competitors tried everything even Flit in his gasoline but that only picked up his speed twenty miles The judges an timers being out to lunch most the time had no idea was he finishing last in one race or winning another so they give him first in most of them an cut cards for his position in the rest of the races At the end the races he had win so much money the officials was thinking offering him a half interest in the field instead It was too bad the races didn't keep on three weeks more so he'd have a endurance record too on account there was plenty witnesses to testify the ship never landed throughout the meet

They was one thrilling event what had been added to this year's program which was having the commercial ships take off over the grandstand They was a number of OX powered ships what amused the boys in the Press Box very much an the Judges an Timers during the dull races an they would make up a pool on which section of the grandstand they would crash into Finely one of them nearly hit the Judges box so the practice was stopped immediate

The place for a married women may be at home, but I begs to state that some of them certainly is at home in the air Outstanding a course was Misses O'Donnell what won the Women's Pacific Derby and Misses Omlie what came in first in the Dixie Derby

Among those in the infield ducking whenever Marcel Doret came by was observed Dick Depew busy selling Fairchilds, business depression or no Andy Heermance an Lew Sevier was also there with news of a great party in Miami on Jan 12, 13 an 14 They promise lots of air races an prizes those days with free admission to anybody with a pilots or mechs license an $1 00 a day rooms in the best hotels A course Florida is a tough place to be, about the middle of the winter, but maybe a few folks will turn out for the game's good.

One thing the Dept of Commerce needs to look into is the education of the pilots as none of them seemed be able to tell was the airport open or closed from the sign on the ground. They got away OK with simple letters like A AC and N in formation even but when it got up to words like open an closed they was sunk

A course I may be accused by my vast no of admires of being very fickle or something when I states that Chicago girls is prettier than any other city except Chestnut Street Philadelphia but that is facts I may have awarded that championship previously to a couple other cities but that don't make no difference Another thing about Chicago is that all distances is measured in taxi fares You ask a fellow how far is a certain place an he says Oh about $1 50 taxi fare" Also they don't use days of the week or dates but every day is Elk's Day or Street Cleaners Day or Eat More Spinach Day I was surprised to see that the Races program wasn't listed something like this 'Thompson Trophy Race Distance $20 00 taxi fare around a $1 25 taxi fare closed course To be held on National Prune Mfrs Day"

Also When I get back to the office I want to tell you about some the outfits the women wears an calls flying togs I think we should have a illustrated style page for lady aviators an I want to edit it We could sell the magazine sure enough then

Y'rs V'y Tr'ly
THE INTREPID AVIATOR

When you grasp the stick and give'er the gun

Your motor responds with a welcome roar—a very short run and you're off the ground—and as you ease the nose of your ship higher and higher up into the blue, you can be sure you're getting the best your plane can give if she's Paragon equipped.

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Before you purchase that air compressor for operating spray gun—for cleaning engines and planes—for tire inflation—for general shop work—be sure to consider carefully every feature of Quincy Compressors.

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Quincy Compressors

are designed and built to deliver air at the lowest possible cost for power and maintenance.

They are rugged and long lived, and so quiet in operation that one is hardly aware of their presence.

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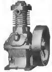
Model F-2

Air cooled and designed especially for service where a large volume of air is required as for paint spray work, engine cleaning and similar work Supplied also in portable form 150 lbs cut off pressure. Displacement 5 cu ft with 1 H P motor; 8.0 cu ft with 1½ H P motor



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Again in* 1930 *the judgment of the pilots who selected* WARNER-*Scarab powered planes is vindicated by winning 73% of the Prize Money awarded in events in which they were eligible

The first Warner engine was produced in 1928, therefore Warners have won every National Air race in which they were eligible

Events in which Warner-powered planes were eligible—1930 National Air Races

(For Approved type Certificate planes)

Class "B" Derbys
Brownsville, Texas, to Chicago
1st John H Livingston Warner-Monocoupe
2nd W G Moore Warner-Inland Sport
Hartford, Conn., to Chicago
1st J Wesley Smith Warner-Monocoupe
2nd Henry J Little, Jr Warner-Monocoupe
Washington, D. C., to Chicago (Women Pilots Only)
1st Phoebe Fairgrave Omlie Warner Scarab-Monocoupe

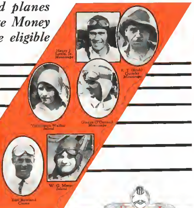
Women Pilots Only
Open Type Plane—500 max cu in
1st May Haizlip Warner-Inland Sport
2nd Vera Dawn Walker Warner-Inland Sport
Cabin Type Plane—500 max cu in
1st Phoebe Omlie Warner-Monocoupe
3rd Gladys O Donnell Warner-Monocoupe
Cabin Type Plane—800 max cu in
1st Phoebe Omlie Warner-Monocoupe
2nd Gladys O Donnell, Warner-Monocoupe

Cabin Type Planes
350 max. cu. in.
1st Vern Roberts, 5 cyl Warner-Monocoupe

Cabin Type Planes
450 max. cu. in.
1st Vern Roberts, Warner-Monocoupe
2nd John Livingston, Warner-Monocoupe
3rd R T (Stub) Quimby Warner Monocoupe
650 max. cu. in.
1st Vern Roberts, Warner-Inland Sport
800 max. cu. in.
1st Vern Roberts Warner-Monocoupe
2nd John Livingston, Warner-Monocoupe
3rd R T Quimby Warner-Monocoupe

Open Type Planes
450 max. cu. in.
1st W G Moore, Warner-Inland Sport
650 max. cu. in.
1st W A Ong Warner-Inland Sport
2nd W G Moore Warner-Inland Sport

Sportsman Pilot Race
Open Type Plane—450 max cu in
1st A Hardgrave Warner-Inland Sport
2nd W G Houston, Warner-Inland Sport
3rd M C Meigs Warner-Inland Sport



WARNER *Scarab* ENGINES

DELIVER AIR, OIL, GAS AT SHIP'S SIDE

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Super-Service

AIRPORT REFUELING UNITS

DUSTING and bumping all over a field to find a refueling station takes the joy and a lot of the speed out of flying. Airports to be popular with pilots must deliver air, oil and gas to ship's side—wherever it lands or wherever it is put on the pan for warming up.

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Air, oil and gas are supplied by either hand or power pumps or both. Oil tanks are fitted with heating coils and thermometers. Filters and meters insure clean fuel and accurate measure. Safety valves, fire extinguishers, pressure gages and flood lights provide every possible safeguard. Working platforms atop cab and side cabinets, coupler for towing planes, trouble light connection, 25 foot lengths of air, oil and gas hose—are some of the other facilities incorporated in Butler Super-Service Refueling Units. Any size unit to fit any size truck and with accessory equipment to suit individual needs will be supplied.

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READY FOR THE FLIGHT

LIEUTENANT Apollo Soucek, U. S. Navy Aviator established world's new altitude record of 43,166 feet on June 4th, 1930 with Wright Apache plane powered with Pratt & Whitney "Wasp" Engine . . . lubricated with

GULFPRIDE OIL 120

Lt. Soucek reports . . . "As far as the engine in the Apache is concerned, it worked perfectly on this record flight . . . *A High Grade Gulf Oil Called GULFPRIDE* was used for lubrication."

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The ENTERPRISE—America's Cup Defender With Her Famous Aluminum Alloy Mast

The Latest Development in Yacht Design!

A SUPERIOR yacht, the famous ENTERPRISE!—defender of America's cup in the international races off Newport, Rhode Island. A masterpiece, embodying many advances in yacht design and equipment

One of the outstanding engineering and construction feats of the ENTERPRISE is her aluminum alloy mast of Martin fabrication Being the first all aluminum alloy mast ever built, it is more durable, and safer, than the finest spruce, and considerably lighter

The Glenn L. Martin Company takes pride in the fact that it was invited by Mr Starling Burgess, famous naval architect, and his brother, Charles Burgess, designer of the mast, to participate in the construction of this yacht.

The Martin Company likewise constructed the special chrome molybdenum mast terminal fittings, special rigging turnbuckles, fittings, and chrome molybdenum steel spreader struts used on the ENTERPRISE

This important work was entrusted to the Martin Company because of its outstanding experience in the construction of aircraft from strong aluminum alloys, its expert knowledge of the fabrication and heat treating of alloy steel and aluminum, having high tensile strength, and because of the exceptional equipment and facilities for the fabrication of metal which this Company has put into existence in its Baltimore Plant

New Martin Flying Boat

The new Martin Flying Boat PM-1, is the Navy's latest service type coast patrol bomber It has proved itself worthy to take a foremost place among the Martin Company's notable achievements in aircraft construction Sixty-five planes of three different designs are now being built by The Glenn L. Martin Company for the United States Navy.

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Builders of Dependable Aircraft Since 1909

BALTIMORE, MARYLAND

THE ONE METAL THAT FLIES BEST

Materials help to sell the plane

Alcoa Aluminum can help you, not only in plane construction, but in selling—and selling is one of the knottiest problems in the airplane industry today.

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PRATT & WHITNEY–

All entries in Non-Stop Derby "Wasp" and "Hornet" powered

"Wosp" corries Wiley Post — winner — Los Angeles to Chicago in 9 hours, 9 minutes, 4 seconds. Others finish full throttle grind within 49 minutes elopsed time.

Wiley Post, winner of the Los Angeles Chicago Derby, stepping out of his Wasp-powered Lockheed at Chicago (P. & A. Photo)

Left to right, Roscoe Turner, Lee Shoenhair, Billy Brock, Art Goebel and Wiley Post, who flew their Pratt & Whitney-powered Lockheeds at an average of 184 miles an hour (P. & A. Photo)

Record of Non-Stop Derby Los Angeles to Chicago

		Pilot	Elapsed Time	Engine
No. 11—Lockheed	First	Wiley Post	9:09:04	WASP
No. 63—Lockheed	Second	Art Goebel	9:21:21.4	WASP
No. 6—Lockheed	Third	Lee Shoenhair	9:39:17	WASP
No. 12—Lockheed	Fourth	Billy Brock	9:53:57	WASP
No. 25—Lockheed	Fifth	Roscoe Turner	9:58:41	HORNET

Perhaps no more convincing demonstration of consistent high speed airplane engine performance has ever been made than in the National Air Race Non-Stop Derby when five Pratt & Whitney powered Lockheed planes were flown from Los Angeles to Chicago at full throttle for some 1760 miles—at an average speed of 184 miles per hour.

Los Angeles to Chicago in 549 minutes! That was the winner's time—an average of 192 miles per hour. The elapsed time of the other contestants checked within 49 minutes. Such a record spells unquestionable reliability and is a supreme tribute to pilots, planes and dependable engine power. With their engines turning well over 2100 r.p.m. all five planes reached their destination with time table regularity.

Back of every aircraft engine bearing the famous "Flying Eagle" seal stand years of experience in the design and manufacture of radial air-cooled power plants. From crankshaft to cotter pins the parts of each "Wasp" and "Hornet" engine have been the subject of constant study and development. Expert craftsmanship dominates each step in manufacture and assembly. Such detailed care pays. How well it pays has been indelibly written in the official time record reproduced at the left.

AT THE NATIONAL AIR RACES

—And "Speed" Holman with "Wasp Junior" *Wins*

**Thompson Trophy Roce
Averoge Speed 201.91 m. p. h.**

PILOTED BY "Speed" Holman, the B. F. Goodrich Rubber Company's Laird Special Speedwing won the Thompson Trophy Race with an average speed of 201.91 miles per hour. Powered with a Pratt & Whitney "Wasp Junior" the plane made a spectacular showing in this 100 mile feature speed event at the National Air Races on September 1.

Flying against a field of planes upon which countless hours of test and research had been expended, the Wasp Junior-Laird combination ably demonstrated its stamina. Only forty minutes before the start of the race was the "Wasp Junior" warmed up and flown for the first time—and then only for ten minutes. Upon completion of this short test the ship was flown from the Laird plant to the starting line and put through a grind which provided additional evidence of the proven dependability of Pratt & Whitney engines.

Speed, reliability . . and power to meet the most gruelling demands! Those are the qualities of Pratt & Whitney engines which have earned for them the enthusiastic endorsement of pilots in military, commercial and private flying. "Wasp" and "Hornet" engines contribute dependable power with faultless regularity day in and day out on airlines throughout the country.

Pictured above are Designer Laird, Pilot Holman and Lee Shoenhair, head of the aviation department of the B. F. Goodrich Rubber Company, with the Laird Special Speedwing powered with a 400 H. P. "Wasp Junior"

THE
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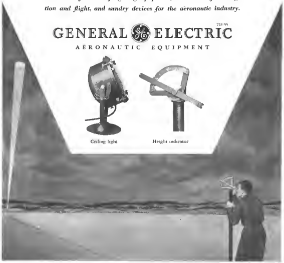
EAST HARTFORD . . . CONNECTICUT
Division of United Aircraft & Transport Corporation

Manufactured in Canada by Canadian Pratt & Whitney Aircraft Company, Ltd., Longueuil, P. Q.; in Continental Europe by Bavarian Motor Works, Munich; in Japan by Nakajima Aircraft Works, Tokyo

Wasp & Hornet *Engines*

THE CEILING LIGHT AND HEIGHT INDICATOR

THE ceiling light and height indicator are used to determine the height of fog or clouds above the ground so that this information may be transmitted along the airway for the benefit of approaching pilots. The ceiling height can be read directly from the indicator scale after the pointer is lined up with the reflection of the light beam upon the clouds. Such equipment is required by the Department of Commerce for an "A" rating of night flying facilities. For complete information, address the nearest G-E office or General Electric Company, Schenectady, N. Y.—manufacturer of lighting equipment, instruments for navigation and flight, and sundry devices for the aëronautic industry.



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LIGHT WILL PUT YOUR AIRPORT ON THE NIGHT MAP OF AMERICA

"THAT FOR YOU ...old wet-blanket!"

"GO AHEAD, clouds. Be damp. Be cold. Blanket the skies with wintry juiciness, if you must. But don't think you'll ground *me!*" . .

Yes, indeed—a pilot should worry about discomfort . . as long as he's wearing a Spalding Wet-Weather Suit similar to the one shown at the right.

The outer shell of waterproof Bedford cloth will shed moisture like a ruffling duck. The inner layer of soft wool fleece will shut out the bitterest cold.

And you can just snuggle your neck and chin deep into the warm, electrified lamb fur collar—and shrug your shoulders at the biting blasts.

Like all Spalding Suits, the one-piece, slip-on suit illustrated at the right is designed to permit perfect freedom of movement. Protectively warm as it is—it is *not* bulky. And five hookless fasteners allow you to put it on or take it off, in short order.

Trim, good-looking, made for long hard wear, this fine suit is one of the most popular ever made by Spalding. Priced fairly, at $65.

Spalding has, of course, a complete stock of flying equipment, carried by all Spalding stores, and at most of the leading flying fields. See it there. Or send in the coupon and get a free catalog.

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Please send free Aviation Catalog

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● A typical dust screen thrown up by a 'take off' on a regularly operated commercial airport

YOU CAN ELIMINATE IT

this New Low Cost Way!

There's no need to describe the damaging effects of dust on airports. Operators know it decreases patronage, and increases motor wear and motor maintenance costs

The expense of eliminating dust has been the barrier, but Gilmore Surfacing engineers have perfected special asphaltic oils and methods of application that make it possible to lay the dust on an entire airport at very little cost and without interruption of airport service. Write today for details, address Aviation Dept., Gilmore Oil Co., 2423 E. 28th St., Los Angeles, Calif.

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Special Asphaltic
AIRPORT OILS

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SAFETY CHUTE

THE PATENTED ONE PIECE COMBINATION PACK COVER AND PILOT CHUTE MAKES THIS THE MOST COMPACT, COMFORTABLE AND QUICKEST OPENING PARACHUTE YOU HAVE EVER SEEN.

A perfect one-piece oil, water and dustproof pack cover that is also a perfect pilot chute—is one of the patented features of the SWITLIK SAFETY CHUTE that makes it so superior. Its small, round, compact shape and the new soft linen harness that fits snug and is really comfortable to wear, make it the favorite with safe flyers everywhere.

The easily accessible pull ring on the side and the three positive opening actions direct from the rip is acclaimed by veteran jumpers for its simplicity and positive action.

And it is so simple and easy to pack. a child can pack it.

These are some reasons for the tremendous popularity of SWITLIK SAFETY CHUTES.

You will want a SAFETY CHUTE, too, for your constant flying companion.

WRITE FOR ILLUSTRATED FOLDER AND SPECIAL OFFER TO PILOTS AND OWNERS.

Switlik Safety Chutes Are Used by Department of Commerce Officials, Air Mail Pilots and Many Famous Flyers.

SWITLIK PARACHUTE AND EQUIPMENT CO.

BROAD AND DYE STREETS, TRENTON, N. J.

Another instance of discriminating choice

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Regard this latest owner of Stearman—Standard Oil Company of California . . . sophisticate in aviation. Consider their judgment . . . their discriminating choice. A guide for you . . . a tribute to Stearman aircraftmanship . . . a respect for the on-the-spot nation-wide service facilities offered by Stearman and the great United group. For every flying reason . . . business or sport . . . Junior Speedmail, 300 H. P., 400 H. P., Business Speedster, 240 H. P. Write, wire or telephone

STEARMAN AIRCRAFT COMPANY, WICHITA, KANSAS
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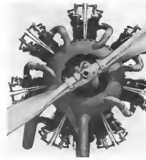
SMOOTHER POWER



Describes . .
the JACOBS MOTOR

RATED H. P.—*140 at 1800 R. P. M.*
MAXIMUM H. P. AT SEA LEVEL —*160 at 2000 R. P. M.*
WEIGHT OF ENGINE—DRY— —*390 lbs.*
NUMBER OF CYLINDERS—*7*
DISPLACEMENT—*528 Cu. In.*
BORE—*4½ In.*
STROKE—*4½ In.*
COMPRESSION RATION—*4.8—1*
OVERALL DIAMETER—*44 In.*
OVERALL LENGTH *33 In.*

A. T. C. 31

Pilots who have flown the Jacobs 140 have marveled at its smoothness and powerful instant response to the throttle. After seeing motors that have flown 700 to 800 hours with not a replacement, they have acclaimed it a "mighty good engine." Quality and simplicity is the standard of the Jacobs 140—all adjustable parts are visible and accessible for instant adjustment—every part is made of highest grade heat treated alloy steel and aluminum. It is built for dependable service under all conditions.

Standard on the Waco 140

JACOBS AIRCRAFT ENGINE CO.

CENTRAL AIRPORT

CAMDEN, NEW JERSEY

Left to right:
Brother George Feltes, pilot, Father Philip Delon and George Pickenpack co-pilot.

The "MARQUETTE MISSIONARY"

The transcontinental flight recently completed by Brother George J. Feltes in a Packard-Diesel powered Bellanca marks a new milepost in aviation history—for it was the first time that a plane crossed the United States under Diesel power.

The Packard-Diesel equipped Bellanca, christened the "Marquette Missionary", was flown with a load of four persons and their baggage from Roosevelt Field to San Francisco over a pre-arranged route—and on a definite schedule which was kept to the minute! The actual flying time was but 34 hours—an average speed of better than 97 m. p. h.

On the 3300 mile coast-to-coast trip only 340 gallons of fuel and 19 gallons of lubricating oil were consumed. This means that the cost of transporting the entire party was *less than one cent a mile!*

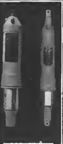
Brother Feltes—the first "flying missionary"—intends to take his Packard-Diesel equipped plane up into Alaska to aid him and his Jesuit Brothers in their work among the Indians and Eskimos. To meet flying conditions in this Arctic country, far from factory service facilities, he particularly required an engine with the utmost reliability—and it is significant that he chose a Packard-Diesel.

Literally it can be said that this new and revolutionary aircraft powerplant is giving "new impetus to flight."

PACKARD

A S K   T H E   M A N   W H O   O W N S   O N E

Changing Emergency Landings from Crises to Incidents . . .



No part of an aeroplane is built from finer materials or with more care and precision than are Aerol Struts.

THE increased acceptance of flying rests upon better control of the plane while being landed under emergency conditions.

Such performance depends upon the plane's minimum flying speed and its landing gear. Manufacturers owe it to their future and to the pilot and the flying public to give their planes maximum landing performance.

That is why an increasingly large group of plane manufacturers have standardized on Aerol Oleo-Pneumatic Landing Struts. Their presence under the plane changes the vast majority of emergency landings from crises to incidents and establish unequaled confidence on the part of the pilot.

The telescoping action of these powerful and efficient cylinders absorbs initial impact, eliminates "crow-hopping" and shortens the roll.

Aerol Struts are made in the Military Type of extreme service and the commercial type for ordinary operation. Complete information will gladly be sent on request.

Aerol Struts are manufactured by The Cleveland Pneumatic Tool Company, Cleveland, Ohio

ASK THE PILOTS WHO LAND ON THEM

AEROL *shock absorbing* STRUT

HAMILTON STANDARD
PITTSBURGH
PENNSYLVANIA
REG. U.S. PAT. OFF.
UNITED DIVISION OF AIRCRAFT & TRANSPORT CORPORATION
PROPELLER CORPORATION

. . . *proven* DEPENDABILITY

The oval red and gold Hamilton Standard Trade Mark is a familiar sight on the propeller blades of military, commercial and privately owned airplanes. And of the basic reasons for this wide acceptance the first is undoubtedly *dependability*.

That thousands of pilots have flown millions of hours without giving a thought to their propellers—absolutely discounting them as a possible source of trouble—is a wonderful tribute to Hamilton Standard *dependability*.

A propeller failure, due to its inevitable consequences, is of the same order of seriousness as a wing or control surface failure. In order to maintain their enviable reputation, Hamilton Standard Propellers are designed to withstand many hundred per cent over-load.

The forerunner of the present types of Hamilton Standard metallic propellers, now in practically universal use in the Army and Navy, withstood *350% over-load* for ten hours without failure.

Hamilton Standard's latest development, with blades only two-thirds the weight of present blades, has just withstood successfully a *700% over-load* in its initial tests. The factors of safety built into Hamilton Standard Propellers contribute materially to *dependability*.

HAMILTON STANDARD PROPELLER CORPORATION

PITTSBURGH, PENNSYLVANIA

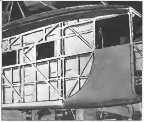
DIVISION OF UNITED AIRCRAFT AND TRANSPORT CORPORATION

Silence » » » »

Pressed Felt » » Insulation » » Reduces Cabin » Noises & Vibration

Air transportation has come to demand comforts comparable with other modes of travel. Vibration and noise must be reduced to an absolute minimum. Pressed Felt is a material unusually well adapted for cabin insulation; it cuts down vibration, deadens sound and offers protection against extreme temperatures. The Felters Company manufacture Pressed Felts especially designed for this purpose and would appreciate an opportunity to discuss your particular requirements.

In addition to manufacturing insulating Felts, the Felters Company manufacture a complete line of Felts for aeronautical purposes; motor washers and gaskets, magneto strips, gas tank strap liners and window channel strips, each designed for its particular purpose. These felts can be furnished in bulk or cut and shaped to your exact requirements. Samples and quotations sent on request.



The FELTERS Company, Inc.

Manufacturers of Felts

99 BEDFORD STREET BOSTON, MASS.

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NEW YORK
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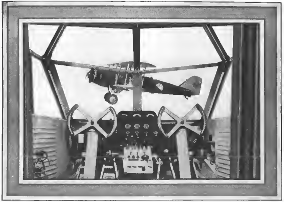
MILLS .. MILLBURY, MASS. .. MIDDLEVILLE, N. Y. .. JOHNSON CITY, N. Y. .. JACKSON, MICH.



These clear Plate Glass Windows will never shatter . . . .

There may be landings on rough ground, but as far as the windows of this 18-passenger Boeing plane are concerned, there will never be a *break-up*. For these windows are laminated, non-shatter glass—the Duplate Corporation's contribution to safer aviation. Available in three types—Duplate, Duolite, and Aerolite, each laminated by the exclusive Creighton process which insures better visibility, permanent lamination, and, of course, 100% protection from shattering. Whatever your requirements in laminated glass, our complete range of thicknesses and weights enables us to supply you promptly through the Pittsburgh Plate Glass Company's warehouses, located in leading cities. Let us send you full information about these safer glasses for aviation, including special *bent* laminated glass. Address Duplate Corporation, Grant Building, Pittsburgh, Pa.

AEROLITE — *Thinnest laminated glass made. Thickness 1/8 to 3/16 in. Weight per sq. ft. 24 to 36 oz.*

DUOLITE — *Flat-drawn sheet glass. Laminated thickness 3/16 in. Weight per sq. ft. 45 oz*

DUPLATE — *Fine plate glass. Laminated thickness 1/4 in. Weight per sq. ft. 48 oz.*

Duplate
CORPORATION
GRANT BUILDING, PITTSBURGH, PA.

SPEED

Travelair Mystery Ship—America's fastest commercial plane. Used by Captain Hawks for both East-West and West-East Transcontinental records.

ENDURANCE

Refueling endurance record, established by Jackson and O'Brine, in the Curtiss Robin monoplane, "Greater St Louis". Former record held by the Hunter Brothers in a Stinson.

RELIABILITY

Waco plane, piloted by Bert Livingston, winner of the last Ford Reliability Tour.

SAFETY

The Curtiss "Tanager," winner of the International Safe Aircraft Competition, organized by the Daniel Guggenheim Fund for the Promotion of Aeronautics, was an extensive user of Haskelite.

PLYWOOD
HASKELITE
PLYMETL

HASKELITE RECORDS

The above record breaking and record holding planes were all equipped with Haskelite, the blood-albumin glued aviation plywood. Practically all the outstanding flights have been made with planes using Haskelite; including the Lindbergh Atlantic flight, Chamberlin Atlantic flight, Dole Pacific flight, Byrd Atlantic flight, "Southern Cross" East to West Atlantic flight.

Haskelite's outstanding quality is further attested by the fact that it has been used by more than 85% of the manufacturers whose planes were entered in the air shows and races in recent years. Haskelite was represented in at least that proportion at the National Air Races, at Chicago.

Write for engineering data on Haskelite and Plymetl (metal-faced plywood) and their aircraft applications.

HASKELITE
MANUFACTURING CORPORATION
120 South La Salle Street, Chicago, Illinois

Curtiss Flying Service

California Panel & Veneer Co.
Los Angeles, Calif.

Air Associates
Garden City, L. I.

Railway & Power Engineering
Corp—Toronto, Montreal,
Winnipeg, New Glasgow

A 9-58 Gray

Chas W "Speed" Holman, who flew the Laird Special Speedwing entered by Lee Shoenhair for the B F Goodrich Rubber Co

WINNERS!

in the Thompson Trophy Race--again it's HOLMAN *and a* LAIRD *Airplane..*

JOCKEYING for position at hair-raising speed, banking up vertically on the turns, sweeping past the fastest ships in the country—thus did "Speed" Holman win the speed epic of the National Air Races. An average speed of 201.91 M. P. H. over twenty laps of a 5-mile triangular course—that is the performance record of the Laird Special Speedwing powered with the Wasp Jr. engine.

Thus was another trophy added to a long line of victories won by the Laird Airplane with Holman at the stick. A sterling pilot—and an invincible airplane!

A striking testimonial to Holman's confidence in the design and workmanship of the Laird Airplane is the fact that this ship was completed only forty minutes before the start of the race—had been test-flown only ten minutes. But Holman—and many other seasoned pilots—know that supreme design and workmanship characterize all the products of Laird shops.

Laird airplanes are built for the sportsman-pilot and the commercial buyer whose chief interest is high efficiency and dependability rather than price. We invite such buyers to write for our free booklet and the name of the nearest distributor, who can arrange a demonstration.

DISTRIBUTORS: Exclusive territories available for established firms with funds and suitable demonstration facilities to handle LAIRD sales. Enlarged factory space and increased production facilities insure prompt delivery.

E. M. LAIRD AIRPLANE COMPANY

Ashburn Field—4500 W. 83rd St., Chicago

Laird Airplanes are manufactured only by the E. M. Laird Airplane Company, Chicago, Illinois

"THE THOROUGHBRED OF THE AIRWAYS"

This high "visibility" roof frees you from leaks, fire, worry and up-keep costs

JOHNS-MANVILLE AIRPORT PRODUCTS

Johns-Manville offers to the Aviation Industry the imperishable building material, *Transite*—for hangar and storage shed construction, for use in wind tunnels, seaplane channels and wherever a fireproof, weatherproof, rot and corrosion-proof building material is desirable

Celite for Concrete is a time-tested workability agent which will increase the speed of handling and placing concrete in runways, sidewalks, hangar walls and floors—wherever concrete is used

The Zeppelin Hangar of the U. S. Navy at Lakehurst, N. J., is protected by a Johns Manville Built-up Roof

Johns-Manville Expansion Joints offer protection against expansion and contraction strains in concrete construction and will keep concrete smooth and prevent cracking through all extremes of weather

A dustless, non-splintering, self healing flooring for taxi strips, hangars and machine shops is available in *Johns-Manville Asphalt Plank*

We'll gladly send you full information on any of these materials

Address JOHNS MANVILLE
292 Madison Avenue New York City
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Please send me a free copy of "Bonded Built up Roofs." BU 2 A

Name ....

Address ....

PROTECT your hangars with *a maintenance-free* J-M ROOF

FIREPROOF and weather-proof, impervious alike to blazing sun and driving rain, a Johns-Manville Built-up Roof offers maximum protection for your hangars and the costly equipment sheltered in them.

Safety and security are the prime requisites of the hangar roof. The conditions it must meet are far more exacting than usually encountered on industrial buildings Johns-Manville Engineers have developed a built-up roofing that gives you, at low cost, a hangar roof that can be applied and forgotten, and that frees you for years to come of expense so far as roof maintenance is concerned

To cover all the requirements of the modern airport, Johns-Manville has available more than twenty types of roofs for use on hangars, air terminals and executive buildings—both asbestos and asphalt roofs, smooth-topped and gravel-topped, roofs that are furnished with orange mineral surface for non-glare, long visibility or in standard black top on which bright colored, contrasting lettering can be used to mark your airport.

300 squares of Johns Manville Class A Built-up Roof with bronze tone cap sheet protect this Curtiss Hangar at Port Columbus, Ohio

Johns-Manville

SERVICE TO TRANSPORTATION

the Stearman Junior Speedmail has BENDIX Wheels and Brakes as standard equipment

Experience continues to teach. More and more manufacturers and operators of planes are learning the common sense value of Bendix Wheels and Brakes—to increase efficiency in landing and ground operations. Let us give you complete information and details.

BENDIX BRAKES have been adopted as standard by—

Alexander Industries, Inc.
Alliance Aircraft Company
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Hamilton Metalplane Division (BOEING AIRCRAFT CO.)
Buhl Aircraft Company
Cessna Aircraft Company
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Curtiss Aeroplane and Motor Co.
Curtiss-Robertson Airplane Mfg. Company
Douglas Aircraft Company, Inc.
Fairchild Airplane Mfg. Corp
General Airplanes Corporation
Keystone Aircraft Corporation
Kreider-Reisner Aircraft Co., Inc.
Joseph Kreutzer Corporation
E. M. Laird Airplane Company
Lockheed Aircraft Company
Mahoney-Ryan Aircraft Corp
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Metal Aircraft Corporation
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Stearman Aircraft Company
Travel Air Company
Verville Aircraft Company
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"Air Mail Saves Time"

BENDIX BRAKE COMPANY
SOUTH BEND, INDIANA
(Division of Bendix Aviation Corporation)

BENDIX (4) BRAKES

FOR SAFETY

Fully protected by patents and applications in U. S. and abroad

PLANES INCREASE IN SIZE
. . . SO MUST HANGARS

ALL-STEEL HANGARS CAN BE ENLARGED TO MEET THE INDUSTRY'S CHANGING NEEDS

FAILURE to plan for future needs has cost many an airport thousands of dollars in obsolescent buildings. The planes of today are midgets compared to those projected for tomorrow. Present hangars must be susceptible to easy enlargement or be dismantled and torn down with heavy loss and little salvage.

Realization of this fact has brought the all-steel hangar to the fore. Its initial cost is far below that of any other incombustible type. Its flexible construction permits alterations or additions in height, width or length and its portable features enable it to be moved with comparatively small cost to other fields in case of abandoning present ports.

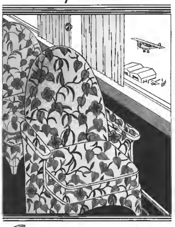
Let us put you in touch with reputable manufacturers of all-steel hangars who will be glad to work with you in planning your port or estimating the costs and requirements of new buildings to care for future, as well as present needs. Address, Trade Research Division, National Association of Flat Rolled Steel Manufacturers, 511 Terminal Tower Building, Cleveland, Ohio.

33' x 100' x 14' Sectional Steel Hangar, Municipal Airport, Sweetwater, Texas. Incombustible and adaptable to changes in height, width or length.

Save
Time Labor Money

with All-Steel HANGARS

.....aircraft travel fabrics by Chase



THE spirit of decoration and utility has been obtained through the medium of Chase VELMO better than with any other upholstery fabric.

And when upholstery is colorful Chase VELMO, the acme of seat luxury in air-way transportation has been achieved. Patterns and textures can be had to conform to all decorative schemes.

To assist further, we now offer you the services of an experienced and recognized stylist who would be glad to suggest or co-operate in shaping up your original ideas.

CHASE
Velmo
UPHOLSTERY FABRICS
made by
SANFORD MILLS, SANFORD, ME.

Then for panel or door trim . . . as covering for operator's chair . . . or as trim on passenger seats in combination with Velmo upholstery . . . specify

CHASE
Leatherwove
Made by
SANFORD MILLS SANFORD MAINE

a scientifically coated fabric that is remarkably serviceable and economically priced.

L. C. CHASE & COMPANY, Selling Agents, Boston
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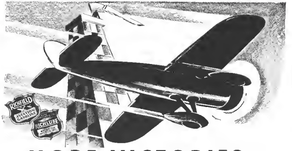
AT THE 1930 NATIONAL AIR RACES



MORE VICTORIES..

in Non-Stop, all Derbies and Closed Course Events

Than All Other Gasolines Combined!

THE world's greatest annual air meet! And Richfield wins the lion's share of the awards...42 victories out of 67 events! *More than all other gasolines combined!!*

Here is conclusive, undeniable proof of quality...dramatic proof that Richfield is unequalled for power, speed and dependability. The fastest planes in the country...the leading pilots...with every well-known brand of gasoline represented. *And Richfield makes virtually a clean sweep of the National Air Races!*

68 Importont Victories and Records in 3 Weeks!

Including the National Air Race events, Richfield registered 68 important victories and records between August 10 and September 1...*the greatest competitive record ever credited to any gasoline!* Among these triumphs with Richfield Gasoline and Richlube Motor Oil are the new junior transcontinental record made by Eddie Schneider, the new solo amphibian record by William Atwater, Ruth Alexander's new Canada-to-Mexico record for women, 1st, 2nd and 3rd Place in the annual Altoona Labor Day speedway event, 21 victories out of 23 events in the world-famous Gold Cup Regatta at Red Bank, N. J....and 1st and 2nd in the spectacular Non-Stop air race to Chicago. .won by Wiley Post with Art Goebel, second!

Get the famous flying qualities of Richfield Gasoline and Richlube Motor Oil for your own plane. Ask for these two famous products by name...*available at important airports both East and West of the Mississippi River.*

IN AIR...ON LAND...ON WATER...RICHFIELD WINS AGAIN...AND AGAIN!

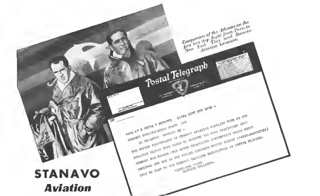
RICHFIELD

RICHFIELD OIL COMPANY—LOS ANGELES—NEW YORK CITY

DISTANCE

COSTE AND BELLONTE

Use STANAVO AVIATION GASOLINE
exclusively on their distance flights



Conquerors of the Atlantic on the first non stop flight from Paris to New York. They used Stanavo Aviation Gasoline.

Postal Telegraph

WASS 67 2 EXTRA U NEWYORK 1138A SEPT 3RD 1930 -
STANAVO SPECIFICATION BOARD INC
26 BROADWAY NEWYORK NY -
THE SUPERB PERFORMANCE OF STANAVO AVIATION GASOLINE USED ON OUR
NON-STOP FLIGHT FROM PARIS TO NEWYORK WAS VERY GRATIFYING STOP
STANAVO WAS CHOSEN ONLY AFTER EXHAUSTIVE CONSUMPTION TESTS WHICH
INCLUDED ITS USE ON THE WORLDS DISTANCE RECORD FLIGHT (PARIS-MANCHURIA)
STOP WE PLAN TO USE STANAVO GASOLINE EXCLUSIVELY ON FUTURE FLIGHTS-
DIEUDONNE COSTE
MAURICE BELLONTE-

STANAVO
Aviation
GASOLINE

introduced but one month ago—is now used by:

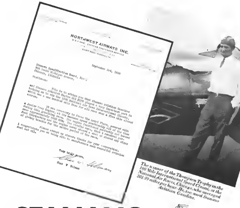
AIR FERRIES, LTD.	N. Y. R. B. A. LINES
BOEING AIRPLANE COMPANY	PACIFIC AIR TRANSPORT, INC.
BOEING AIR TRANSPORT, INC.	PAN-AMERICAN AIRWAYS, INC.
COLONIAL AIR TRANSPORT	PAN AMERICAN-GRACE AIRWAYS, INC.
GORST AIR TRANSPORT	SEATTLE VICTORIA AIR MAIL
MAMER AIR TRANSPORT	VARNEY AIR LINES

ENDORSED BY LEADING ENGINE MANUFACTURERS

- SPEED -

CHARLES "SPEED" HOLMAN

captures the 1930 speed classic with
STANAVO AVIATION GASOLINE



NORTHWEST AIRWAYS INC.
SAINT PAUL MINNESOTA

September 3rd, 1930

Stanavo Specification Board, Inc.,
910 South Michigan Avenue,
Chicago, Illinois

Gentlemen:

This is to advise you that Stanavo Aviation Gasoline and Stanavo Aviation Engine Oil #120 played a very important part in helping me to win the 1930 National Air Race International Classic, which was a one hundred mile free for all race over a five mile closed course.

It was necessary to force the Laird Plane, powered with a Junior Wasp Engine, at its maximum speed practically all of the time during this grueling race. The engine functioned perfectly and burned over approximately 2600 RPM. The results were, that I received perfect lubrication and the engine never missed a shot or showed any signs of giving trouble for the entire period of the race.

Please accept my sincere thanks for your cooperation. I congratulate you on being able to manufacture such wonderful aviation fuel and oil.

Very truly yours,

Chas W Holman

The winner of the Thompson Trophy in the 100 Mile International Speed Classic, at the National Air Races, Chicago, who averaged 201.99 miles per hour. He, too, used Stanavo Aviation Gasoline.

STANAVO

AVIATION GASOLINE

STANAVO SPECIFICATION BOARD, INC.

Organized and maintained by

Standard Oil Company of California	Standard Oil Company (Indiana)	Standard Oil Company of New Jersey
225 Bush St., San Francisco	910 S. Michigan Ave., Chicago	26 Broadway, New York City

And AGAIN . . .
The National Air Races prove that BELLANCA builds America's most Efficient airplane

AT the National Air Races at Chicago, the Detroit News Trophy and the Aviation Town and Country Club Trophy, annual classic efficiency contests, were again won by Bellanca airplanes. This makes the fourth time Bellanca has taken the one trophy, and the eighth time the other. In three events entered at Chicago, of which two were doubled, Bellanca planes won two firsts, two seconds and three third places. At the Canadian National Exposition Seaplane Race, out of a field of five, the Bellanca Pacemaker Seaplane won first prize for efficiency and speed by an enormous margin.

These are the only contests in which efficiency or carrying capacity are taken into account instead of "speed regardless of efficiency." The winning of these contests once again definitely proves that Bellanca airplanes carry the largest cargo at the greatest speed, at the lowest cost—as well as with that degree of safety for which Bellanca planes have always been famous.

To the individual and commercial owner, this is the measuring stick by which the value of aircraft must be judged—it is the combination of speed and good business.

Complete Bellanca specifications, and correct data on all National Efficiency Contests since 1920, sent on receipt of your letterhead.

BELLANCA AIRCRAFT CORPORATION
New Castle, Delaware
New York Office: Chrysler Building
Canadian Distributors: Bellanca Aircraft of Canada, Ltd., Montreal

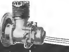
BELLANCA

IRELAND AMPHIBION

TRADE IRELAND MARK

Equipped with HEYWOOD STARTER

SKY SERVICE



Because of its dependability and ease of operation, the Heywood Starter has been selected as standard equipment on the famous "Privateer", manufactured by the Ireland Aircraft Company.

Like many other manufacturers of fine planes, Ireland realizes that the Heywood offers the last word in starting efficiency.

Made of Bohnalite, the new light alloy which is 62% lighter than iron, the Heywood Starter combines extreme lightness with great strength.

Unfailing service, instant response, the convenience of starting from the pilot's seat, are only a few of the features which have made the Heywood the choice of many of the leading pilots and manufacturers of aircraft.

SKY SPECIALTIES CORPORATION
3651 Hart Avenue — Detroit, Michigan

We comb the country

.... for this scarce and costly metal!

TO the eye... merely scrap... an unsightly, tangled mass of metal. Yet we have to shop the country over to find it!

It is one of the several materials used in making acid steel for Roebling Steel Wire Aircraft Products... and is the purest low phosphorus melting stock obtainable... scarce... expensive.

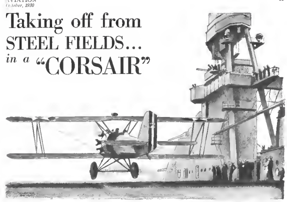
We spend a lot of time searching for this costly metal... and in analyzing it. We also exercise an extraordinary amount of care in selecting other melting stock... the purest of acid open hearth pig, of ore, and of fuel... likewise scarce and expensive ingredients.

It takes more time and patience... this old-fashioned thoroughness... this close attention to details. *But it produces Roebling Aircraft Wire, Strand and Cord!*

JOHN A. ROEBLING'S SONS COMPANY
WIRE . WIRE ROPE . WELDING WIRE
COPPER & INSULATED WIRES & CABLES
TRENTON, N. J. *Branches in Principal Cities*

ROEBLING WIRE AIRCRAFT PRODUCTS

Taking off from STEEL FIELDS... *in a* "CORSAIR"



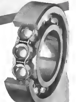
One way to get an idea of flying from the deck of an aircraft carrier ... and landing on the same steel field... is to mark off the overall length and beam of a carrier on an ordinary field. Look at it from the air. It's a mighty small area.

Even with a carrier steaming into the wind at twenty to twenty-five knots, a plane has to be fast for deck take-off. For deck landing a plane must be rugged beyond all ordinary standards of flying to stand the strain of the unyielding surface and the arresting gear. And its control must be positive to compensate instantly for the roll and pitch of the ship.

"Corsairs" stand this exacting service and stand it well. Sound design and rugged durability have won them adoption as standard observation ships in the U. S. Naval Air Service. And the same qualities have earned for them in civil life the enthusiastic approval of many nationally known pilots who know their airplanes. CHANCE VOUGHT CORPORATION. Division of United Aircraft & Transport Corporation, East Hartford, Connecticut.

CHANCE VOUGHT  CORPORATION

One of the five "Miss Silvertown", "Wasp"-powered Lockheed Vega piloted by Mr Lee Schoenhair



SRB Ball Bearings

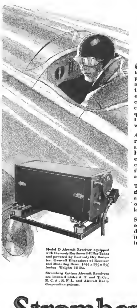
... used in the "Wasp" and "Hornet"-Powered Lockheed Vega Fleet on record trip from Los Angeles to Chicago (1760 miles) in less than 10 hrs.

In the five Pratt and Whitney "Wasp" and "Hornet" engines that powered the ships of Post, Goebel, Schoenhair, Brock and Turner, in the memorable non-stop cross-country Derby, on August 26th, SRB Ball Bearings were standard equipment at important points. SRB Ball Bearings typify in capacity, material, workmanship and dependability all that is outstanding in Ball Bearing design. Naturally they are in such world-known engines as Wright, Curtiss, Warner, Lycoming and others.

Ball SRB Bearings

STANDARD STEEL AND BEARINGS INCORPORATED
Plainville *Connecticut*
DIVISION OF MARLIN-ROCKWELL CORPORATION
PACIFIC COAST DISTRIBUTORS
F. M. Cobbledick Co., San Francisco Cal. E. D. Maltby Co., Los Angeles, Cal.
Northwest Bearings Co., Seattle Wash

Announcing a New
"UNIVERSAL" AIRCRAFT RECEIVER



Model D Aircraft Receiver equipped with Eveready Raytheon 4-Pillar Tubes and powered by Eveready Dry Batteries. Over-all Dimensions of Receiver and Mounting Base: 16½ x 9¼ x 9¼ inches Weight: 18 lbs.

Stromberg Carlson Aircraft Receivers are licensed under A. T. and T. Co., R. C. A., R. F. L. and Aircraft Radio Corporation patents.

Adaptable to the Entire Aircraft Radio Spectrum

STROMBERG-CARLSON'S new model D Aircraft Radio Receiver marks another chapter in the promotion of greater *safety* in flying. The result of almost two years' research and experimentation, this highly advanced type of instrument is the first of its kind employing interchangeable coil sets for covering the entire frequency range allotted to aircraft. Interchangeability is accomplished easily and quickly because of the unique manner in which these coil sets are mounted upon a special panel with attached handle for insertion or removal.

Aircraft reception of radio range signals, weather reports and all other radio aids to the operation and *safety* of flying, are provided for in this receiver. It is designed particularly to overcome the adverse conditions met in aircraft service. Its outstanding electrical characteristic is an especially favorable signal to noise ratio accompanied by high sensitivity and selectivity at every tuning position.

The extreme simplicity of its mechanical construction will appeal at once to both the aeronautical engineer and the radio technician. Simplification of the controls removes all need for special radio knowledge in so far as operation is concerned.

Stromberg-Carlson Model D Aircraft Radio is one of the most important radio *safety* devices ever developed for aircraft usage. Write today for our interesting descriptive brochure containing full information regarding the new Model D Receiver.

STROMBERG-CARLSON TELEPHONE MFG. CO., ROCHESTER, N. Y.

Address all inquiries to our sales representative, Aircraft Radio Corporation, Boonton, N. J.

Stromberg-Carlson

MAKERS OF VOICE TRANSMISSION AND VOICE RECEPTION APPARATUS FOR MORE THAN THIRTY-FIVE YEARS

You don't want VALVE TROUBLE when your'e at "THE CEILING"

THE aviation work-shop is one place where they don't take chances. Particularly when it comes to maintaining the air-worthiness of ships. That's why you find Van Dorn Aircraft Valve Refacers on the job at airports throughout the country, doing their bit to keep aircraft engines in condition to fly "high, wide and handsome." Real precision grinding machines with ball-bearing wheel shaft and "twin-grip" collets for chucking valves accurately. Work-head can be rotated from 0° to 90°, accommodating all valve angles. Such smooth, easy operation! Does a real job—the kind of a job the veteran airman likes and wants. Why not learn more about Van Dorn Aircraft Valve Refacers? Write for catalog of complete line.

Buy from Your Distributor

"Van Dorn" ELECTRIC TOOL CO.
TOWSON · · MARYLAND

At the NATIONAL AIR RACES

BG *Mica Aviation Spark Plugs*

were the Overwhelming Choice of Competing and Visiting Pilots.

99% OF ENGINES OVER 225 HP. (213 ENGINES)

86% OF ENGINES OVER 100 HP. (378 ENGINES)

75% OF ALL ENGINES (475 ENGINES)

were BG equipped.

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FOR THE

FORD PLANE

THE speed of the Ford tri-motored, all-metal transport has been materially increased. At the recent air races in Chicago, a Ford 5-A.T. plane, equipped with three Pratt & Whitney Wasp engines, won the multi-motored race with an average speed of 144.24 miles per hour.

Maximum speed of the 5-A.T. has been increased from 135 to 152.5 miles per hour, and the cruising speed is now 122 miles per hour instead of 112.

The new plane takes off after a shorter run, climbs faster than the former model, and has the same landing speed.

Added speed has been attained through painstaking refinements of fuselage and nacelle design but without expenditure of additional power.

This marked advance in aeronautical design causes a material decrease in mileage cost of operation.

Transport operators see in this plane the opportunity of accelerated air line travel by increasing inter-city cruising speeds, and, at the same time, decreasing their operating costs.

SPECIFICATIONS OF FORO 5-A.T. TRI-MOTORED ALL-METAL TRANSPORT

Gross weight	13,500 lbs.
Empty (but completely equipped for passenger service)	7,600 lbs.
Disposable load	5,900 lbs.
Pay load	3,643 lbs.
Maximum speed	152 5 m.p.h.
Cruising speed—at 1700 r.p.m.	122 m.p.h.
Stalling speed	64 m.p.h.
Range with standard fuel capacity	560 miles
Climb—at sea level	1,050 ft. per min.
Climb from sea level in 10 min	8,000 ft.
Ceiling—Service 3 motors	18,500 ft.
Absolute 3 motors	20,500 ft.
Absolute (any 2-engine combination)	10,500 ft.
Dimensions—General Span	77′ 10″
Length	50′ 3″
Height	12′ 0″
Tread	18′ 7″
Cabin Width	4′ 6″
Height	6′ 0″
Length	18′ 9″
Volume	529 cu. ft.
Area Wing	835 sq. ft.
Passenger accommodations	
Removable Seats	13 to 15
Baggage Space	30 cu. ft.
Gasoline capacity	277 to 355 gals.
Oil capacity	34 gals.
Power—Engines	3 Wasps
Total Power	1260 H.P.

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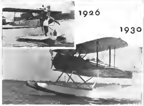

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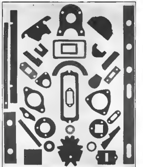

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FOR SALE

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(Continued from preceding page)

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Hitting 250 miles per hour on the down-swings—flying 60% of the way upside down—

Over Curtiss-Wright Field at Beresford, California, July 6—Paul Mantz, Chief Pilot of the Palo Alto School of Aviation, put his Fleet Biplane through 46 outside loops for a new official N. A. A. record. Centrifugal force tended to pull wings, motor and Mantz himself away from the little ship every time he nosed her over. At the bottom of each loop, his own weight put a thousand pounds pressure on the fuselage. And during each loop—with centrifugal force throwing the oil away from the pump—just a film of Stanavo lubrication saved him from a wide-open engine coming to grief!

Yet the film of Stanavo Aviation Engine Oil *stood up* under the hardest test in flying! This World-Champion lubricant that set the 46 Outside Loop Record is the one custom-built flyer's oil—available and *"uniform the world over."*

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In the 22 events entered Wright-powered planes romped home with 15 firsts, 11 seconds and 12 third places . . . 82% of the possible places!

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Wright is proud, but not unduly, of this splendid showing. For its engines performed just as they always do at Air Races . . . and as they're doing every day the world over, in millions of miles of dependable flying by sturdy modern ships!

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